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CAPACITY BUILDING FOR OPERATION AND MAINTENANCE OF WATER INFRASTRUCTURE AND DEVELOPING SMALL WATER INFRASTRUCTURE IN THE WEST BANK AND GAZA

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EPIQ II
Making Policies Work for People

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EXECUTIVE SUMMARY

PURPOSES

The purposes of this evaluation are to:

1. Assess the potential for different approaches and strategies to develop Operations and Maintenance (O&M) capacities in different entities in the Palestinian water sector in order to ensure that investments in the water sector continue to work (i.e., are sustainable in the long-term); and
2. Identify and compare the relative pros and cons of different approaches and contractual mechanisms for developing small-scale water infrastructure.

METHODOLOGY

As a subcontractor to IRG under the Environmental Policy and Institutional Strengthening IQC (EPIQ II), ECODIT fielded a team of three water engineers and development professionals for this task order. Between May 16 and June 4, 2004, the evaluation team:

- Held a kickoff meeting at the USAID Mission offices in Tel Aviv, as well as one-on-one meetings with USAID technical and contracts staff to collect data, get input and guidance;
- Met with over 50 professionals working on small and large water projects in the West Bank, including the directors, department heads, managers, senior staff and engineers at PWA, WBWD, PVOs, US Contractors, and other donors;
- Visited a dozen small and large water project sites in the Bethlehem-Hebron region in the south and in the Jenin region in the north;
- Organized a mid-course workshop (on Thursday May 27, 2004) in Ar-Ram, in which over 30 participants from PWA, WBWD, PVOs, contractors and USAID actively participated;
- Held a round table (on Saturday May 29, 2004) at the West Bank Water Department with the key professionals (11) in charge of Operations and Maintenance of water systems in the West Bank;
- Debriefed the USAID/WBG Mission and presented the draft evaluation report (on Friday June 4); and
- Prepare this final report incorporating comments received from USAID/WBG and select contractors and PVOs.

USAID instructed the evaluation team not to go to the Gaza Strip due to the volatile security situation there.

CAPACITY BUILDING FOR O&M:

FINDINGS AND RECOMMENDATIONS

Recent and ongoing capacity building efforts by USAID and other donors have put in place the major building blocks for sustainable operation and maintenance of the large water infrastructure in the West Bank, and also have highlighted some remaining gaps and limitations in basic O&M capabilities, as summarized by the following mix of strengths and weaknesses:

- A PWA/WBWD that is in a transition phase, with:
  - No current O&M responsibility for water supply wells under control of Mekorot, the Israeli water company, but which eventually would/could come under Palestinian control and O&M responsibility in the final status negotiations
  - Gradually increasing O&M responsibility for nine new public water supply wells and associated bulk water supply and transmission facilities that were built with USAID (and other donor) support and are gradually being be turned over to PWA/WBWD
- Complementary efforts of other donors, ranging from:
  - Developing the capabilities of PWA as a regulatory body, including setting tariffs (Dutch-Norwegian technical assistance)
  - Helping the WBWD transition into the National Water Utility, with a focus on improving its capabilities to manage the bulk water supply system and reduce Unaccounted for Water: e.g., detect and repair leaks, repair bulk water meters, prepare study and TOR for a SCADA, develop Computerized Maintenance Management System (French technical assistance)
  - But none focusing on developing technical capabilities to operate and maintain the bulk water supply infrastructure built with USAID support
- A reasonably motivated O&M field team that has a set of core qualifications, acquired through hands-on and formal training and twinning with international experts, but that:
  - Lacks qualified leadership and management oversight
  - Must continue to improve its skills and know-how for basic O&M and small repairs
  - Needs to have well-defined roles and responsibilities within PWA/WBWD
- A highly performing and cost-effective well service rig and an efficient service rig team with a qualified team leader with years of relevant experience gained working in the Gulf
- A reasonably well-equipped Maintenance Facility in Ramallah, but for which:
  - Short-, mid- and long-term goals have yet to be defined (e.g., in-house diagnostics and repairs versus outsourcing)

  - Technician capabilities need to be honed through targeted training & routine practice
  - Supplemental equipment and spare parts may be needed to support its objectives
  - Linkages with the field O&M capabilities and roles must be developed
- General neglect of the O&M needs and requirements of water infrastructure owned and operated by small municipalities and villages councils, characterized by:
  - Ad-hoc and sub-standard support from WBWD due to unclear mandate, difficulties of access to different regions, lack of standardization of equipment
  - Lack of O&M response capabilities at the regional level (spare parts, repair equipment, certified technicians, O&M notification and response procedures for timely support)

Therefore, building on the lessons-learned from the capacity building efforts to date, and taking stock of the current strengths and weaknesses summarized above, the evaluation team has recommended the following measures to continue to build O&M capacity:

1. Finalize bulk water pump station construction issues to enable receipt of works by PWA/WBWD;
2. Hire an experienced, senior pump station O&M specialist to oversee the operations and maintenance of the bulk water system;
3. Conduct teambuilding and develop organizational capabilities for O&M, including gender balanced staffing and approaches;
4. Develop and implement an O&M plan that provides for transitioning from outsourcing of repairs to doing some repairs in-house and includes "training for results" and targeted procurement of equipment and spare parts;
5. Separate O&M of the well stations from O&M of the bulk water transmission system;
6. Address travel and access difficulties, including with regard to O&M of the Jenin 2 well;
7. Weigh carefully the implications of implementing a SCADA system;
8. Build on the Computerized Maintenance Management System to be developed under the French technical assistance program
9. Provide basic repair and maintenance equipment; and

TEAM'S RECOMMENDATIONS FOR FUTURE WATER PROJECTS

- Require the review of preliminary design alternatives by relevant parties and outside experts, including Value Engineering
- Use equipment manufacturers whose representatives can and will come as necessary to WBG
- Keep projects as simple as possible (i.e., use appropriate technologies for WBG)
- Conduct periodic lessons-learned workshops to share experiences and skills
- Incorporate O&M planning needs from the outset of each project

10. Develop capabilities to estimate and monitor the short- and long-term yields of the new deep wells (and other wells, as appropriate) under anticipated operating scenarios.

The Ramallah Maintenance Center needs to become fully operational before additional investments are made in similar maintenance facilities in the North or in the South. This will require achieving a certain level of organizational development and O&M planning capabilities. However, the team recommends setting up two regional warehouses (spare parts, small equipment and repair tools), one in the North and one in the South, to provide quick-response capability for repair and maintenance of small water infrastructure in each region. These regional warehouses could become over time the nucleus of the future Regional Maintenance Centers. Also, establishing a laboratory in the South to house basic electronics testing equipment as well as basic repair tools and parts may be necessary in the short term.

DEVELOPING SMALL-SCALE WATER INFRASTRUCTURE:

FINDINGS AND RECOMMENDATIONS

The evaluation team visited a selection of small-scale water infrastructure projects in the West Bank and met with the beneficiaries, implementing partners (PVOs and contractors) and operators (village councils or joint service councils) of those projects. Based on those visits and meetings, as well as the brainstorming sessions and discussions held at the mid-course workshop in Ar-Ram and the WBWD roundtable in Ramallah, the evaluation team observed the following:

1. The need and demand for small-scale water infrastructure projects in WBG is likely to continue in the foreseeable future, even assuming an end to violence and closures;

2. In some instances, water construction projects implemented under Cooperative Agreements using local NGOs and contractors have not met basic construction quality standards (e.g., leaking water reservoirs);

3. Most small-scale water infrastructure projects are implemented without paying much attention to the basic requirements for ensuring the long-term durability of the infrastructure;

4. It may not make economic sense to build the individual capabilities of small municipalities and villages to undertake basic O&M of basic water infrastructure, such as repairing water pipelines and replacing water valves, let alone slightly more complicated equipment such as small booster pumps; and

5. More needs to be done to disseminate and build upon the skills and knowledge of local Palestinian "utilities," such as the Jerusalem Water Undertaking and the Jenin Joint Services Council, in order to incorporate the lessons learned from the Palestinian experience into the planning, design, implementation and O&M of future small-scale water projects.

USAID/WBG has implemented most small-scale water infrastructure under a single contract or cooperative agreement between USAID and a contractor or international NGO/PVO, respectively (integrated package). In a few instances, USAID/WBG has implemented small-scale water infrastructure by splitting the project

into two packages, one for construction supervision (with design) and one for construction, and entering into a direct contract or cooperative agreement with a firm or PVO for each package.

Advantages of integrated package approach. Entering into a direct contract or cooperative agreement with an international firm or PVO, respectively, to implement all aspects of a small-scale water infrastructure program would provide USAID with several key advantages as follows:

- One party is responsible for the program vis-à-vis USAID;
- Better program results through integrated implementation;
- Opportunity to provide technical assistance in support of individual small-scale water infrastructure projects as part of the integrated package: i.e., liaison with PWA/WBWD and consistency with national plans, review and approval of engineering designs, quality control of construction, and gradual development of regional O&M capabilities;
- No upper limit on the size of an integrated package contract or Cooperative Agreement with an international firm or PVO; and
- Reduced management burden on USAID as the Contractor or PVO would be responsible for managing and implementing the key aspects of the small-scale water infrastructure program under the direction and supervision of the CTO and FSNs throughout the WBG.

At the same time, the integrated package approach should allow USAID the flexibility to build on and take advantage of the respective skills and experiences of US and local firms and PVOs/NGOs to plan, design and implement small-scale water infrastructure projects and to provide institutional development and public awareness support to such projects.

Characteristics of ideal contractual mechanism. In light of the comparative pros and cons of different contractual mechanisms, the ideal contractual mechanism to implement a small-scale water infrastructure program in the West Bank & Gaza over the next few years would be for an integrated package that would allow the implementing organization to:

- Draw on the comparative skills offered by international and local firms and NGOs
- Respond to emergencies should they continue to arise
- Offer technical assistance to ensure the long-term sustainability of *small-scale water infrastructure* (e.g., built-in requirements for O&M, building blocks for future regional utilities)

Technical assistance requirements under such small-scale water infrastructure package would need to include the following:

- Provide overall coordination of the small-scale water infrastructure program
- Liaise with PWA/WBWD to ensure consistency with national plans, strategies and standards

- Manage the implementation of small-scale water infrastructure projects under the program. *For example,* work with PWA & USAID to:
  - Select priority projects
  - Prepare RFPs or RFAs and solicit bids (to ensure cost-competitiveness)
  - Evaluate proposals/applications and select winning bids
  - Award projects to PVOs, local firms or local NGOs through grants, Purchase Orders, or subcontracts
- Review engineering designs, especially for large or complex water projects (e.g., wells, force mains), for quality assurance/quality control, and provide overall supervision of construction works
- Assist PA/WBWD to:
  - Set up two regional warehouses (spare parts, small equipment and repair tools), one in the North and one in the South, to provide quick-response capability for repair and maintenance of small water infrastructure in each region. These regional warehouses could become over time the nucleus of the future Regional Maintenance Centers
  - Provide O&M support to small municipalities, village councils and Joint (water) Services Councils, tapping the hardware resources of the regional warehouses
  - Develop O&M support procedures for small-scale water infrastructure at the regional level

GUC-PLUS CONTRACTUAL MECHANISM TO IMPLEMENT SMALL-SCALE WATER INFRASTRUCTURE PROGRAM

If feasible, a direct contract with an international firm under a GUC mechanism, or equivalent, to provide grants (Fixed Obligation Grants or simple grants), purchase orders, and/or subcontracts to international PVOs, local NGOs, local engineering firms, and local contractors to build or rehabilitate small-scale water infrastructure in the West Bank & Gaza. Such a *GUC-plus* contractual mechanism would provide the flexibility needed for USAID to implement a wide range of water projects under a range of field conditions. It would have most of the pros of the three possible integrated package options (direct contract, Cooperative Agreement, and GUC) while at the same time minimizing the cons. Such a mechanism, if feasible, would offer the characteristics described above. In particular, it would ensure long-term sustainability by:

- Building O&M requirements into all projects, from design to implementation and beyond
- Building the capacity of PWA/WBWD to provide decentralized support to small municipalities and village councils
- Paving the way for one or more future Regional Utilities through the gradual establishment and operation of Regional Maintenance Centers, beginning with the establishment of regional warehouses under the program

ACRONYMS

ANERA	American Near East Refugee Aid
ARD	Associates in Rural Development
CAMP	Coastal Aquifer Management Project
CSP	Community Services Program
CEP	Center for Engineering and Planning
CFR	Code of Federal Regulations
CHF	Community Habitat Finance
CCMS	Computerized Consumer Management System
CMMS	Computerized Maintenance Management System
COP	Chief of Party
CRS	Catholic Relief Services
CTO	Cognizant Technical Officer
EHP	Environmental Health Project
EPA	Environmental Protection Agency
EPIQ	Environmental Policy and Institutional Strengthening Indefinite Quantity Contract
IQC	Indefinite QuantitY Contract
HDPE	High-Density Polyethylene
EWOC	Emergency Water Operations Center
FSN	Foreign Service National
GDO	General Development Office
GUC	Grants Under Contract
ICRC	International Committee of the Red Cross
IRG	International Resources Group, Ltd.
JSC	Joint Services Council
JWU	Jerusalem Water Undertaking
GIS	Graphical Information System
MOF	Ministry of Finance
MP2	Maintenance Package software (see http://www.datastream.net)

NGO	Non-Governmental Organization
NWU	National Water Utility
O&M	Operations and Maintenance
PM	Preventive Maintenance
PMU	Project Management Unit
PIP	Performance Improvement Planning
PVO	Private Voluntary Organization
PWA	Palestinian Water Authority
QA/QC	Quality Assurance/Quality Control
RFA	Request for Applications
RFP	Request for Proposals
SCADA	Control and Data Acquisition System
SCF	Save the Children Federation
SO	Strategic Objective
SWIFT	Small Water Infrastructure Fast Track
TA	Technical Assistance
TOR	Terms of Reference
UNDP	United Nations Development Program
USAID	US Agency for International Development
VFD	Variable Frequency Drive
WWTP	Wastewater Treatment Plan
WBG	West Bank and Gaza
WBWD	West Bank Water Department
WEDO	Water & Environmental Development Organization
WR	Water Resources
WRO	Water Resources Office
WRP	Water Resources Project
WWT	Wastewater Treatment

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INTRODUCTION

USAID/West Bank & Gaza has issued a Task Order to IRG to prepare an "Evaluation of the USAID/West Bank & Gaza Water Resources Program." This report presents the findings and recommendations of this evaluation. This introductory chapter presents the following:

1. Purposes
2. Background
3. Methodology
4. Organization of Report

PURPOSES

The purposes of this evaluation are to:

1. Assess the potential for different approaches and strategies to develop Operations and Maintenance (O&M) capacities in different entities in the Palestinian water sector in order to ensure that investments in the water sector continue to work (i.e., are sustainable in the long-term); and
2. Identify and compare the relative pros and cons of different approaches and contractual mechanisms for developing small-scale water infrastructure.

Although USAID/WBG did not have to do this evaluation, the Mission has requested it to identify the lessons-learned of the recent experience and efforts in capacity building for O&M (in particular CH2MHill under WRP3) and small-scale water infrastructure (in particular CDM under EWOC and the Community Services Program). These activities are to be completed soon and the Mission wants to harness the lessons learned from them for guidance in new programs.

The focus of the capacity building assessment is on O&M needs and opportunities in support of water infrastructure built by USAID, large and small. The primary interest is in developing O&M capacity in the West Bank, as the World Bank is working on a coastal utility for the Gaza Strip.

This evaluation is one of at least three evaluations undertaken, or to be undertaken, by USAID/WBG and should not be confused with them. The other two pertinent evaluations are:

1. *Large infrastructure contractor performance:* Upcoming evaluation of how the prime contractors–Metcalf & Eddy under CAMP, CH2MHill under WRP2 and WRP3, and CONTRACK under WRP2--performed on infrastructure works and related capacity building/institutional support, including cost controls, quality of construction, and other factors.
2. *Evaluation of the Community Services Program (CSP):* Ongoing, traditional evaluation of small infrastructure built by PVOs (ANERA, Save the Children, CHF, CARE, Catholic Relief Services) through Cooperative Agreements under Strategic Objective 8.

Appendix A presents the Scope of Work of this evaluation as provided by USAID/WBG.

BACKGROUND

Water resources development has been the largest program for the USAID Mission to the West Bank and Gaza since 1997. Most of the funds have gone to large infrastructure projects that serve tens- or hundreds of thousands of people, such as the Bethlehem-Hebron transmission and storage system, and the Jenin Villages program. However, significant ancillary programs of institutional development and capacity building have also been a fixture of USAID's water portfolio, and many local infrastructure projects, generally costing less than one million dollars each, have been implemented within the water program.

METHODOLOGY

As a subcontractor to IRG under the Environmental Policy and Institutional Strengthening IQC (EPIQ II), ECODIT fielded a team of three water engineers and development professionals for this task order as follows:

- Joseph Karam, Team Leader;
- Barnes Bierck, International Water Management Specialist; and
- Nader Al-Khateeb, Local Water and Development Specialist.

Appendix B lists the key meetings and site visits undertaken by the evaluation team during the mission. Messrs. Karam and Bierck arrived in Tel Aviv on Sunday May 16 and spent the first two-and-half days meeting with USAID staff at the Tel Aviv Mission: kickoff meeting, one-on-one meetings with USAID technical and contracts staff to collect data, get input and guidance, etc. After this initial learning curve, Messrs. Karam and Bierck left for Jerusalem and the West Bank, where Mr. Al-Khateeb joined them for the remainder of the mission. Between May 20 and June 4, the team:

- Met with over 50 professionals working on small and large water projects in the West Bank, including the directors, department heads, managers, senior staff and engineers at PWA, WBWD, PVOs, US Contractors, and other donors;
- Visited a dozen small and large water project sites in the Bethlehem-Hebron region in the south and in the Jenin region in the north;
- Organized a mid-course workshop (on Thursday May 27, 2004) in Ar-Ram, in which over 30 participants from PWA, WBWD, PVOs, contractors and USAID actively participated (see Appendix C, Mid-Course Workshop Report);
- Held a round table (on Saturday May 29, 2004) at the West Bank Water Department with the key professionals (11) in charge of Operations and Maintenance of water systems in the West Bank (see Appendix D, Round Table Report); and
- Debriefed the USAID/WBG Mission and presented the draft evaluation report (on Friday June 4).

USAID instructed the evaluation team not to go to the Gaza Strip due to the volatile security situation there. The evaluation team tried to speak on the phone with the Director of the Palestinian Water Authority, Mr.

Nabil Sherif, but was not able to do so due to Mr. Sherif's very busy schedule (e.g., he attended the International Water Demand Management Conference in Jordan).

ORGANIZATION OF REPORT

This report is organized in four chapters and three appendices as follows:

- *Chapter 1, Introduction* is this chapter;
- *Chapter 2, Recent and Ongoing Capacity Building Efforts* reviews USAID and other donor support activities to O&M of water infrastructure projects and identifies key successes and difficulties of some of those efforts;
- *Chapter 3, Needs and Opportunities for O&M Capacity Building* presents the evaluation team's findings and observations regarding key O&M of water infrastructure issues in Palestine, and identifies the needs and opportunities for further O&M capacity building to ensure the long-term sustainability of this infrastructure;
- *Chapter 4, Mechanisms for Developing Small-Scale Water Infrastructure* analyzes the pros and cons of alternative contractual mechanisms that USAID has used, in light of recent and ongoing experience, and could use to develop small-scale water infrastructure in the West Bank & Gaza in the near future.
- *Chapter 5, Conclusions* presents the evaluation team's conclusions.
- *Appendix A, Scope of Wor*k for the current effort, titled "Evaluation of the USAID/West Bank & Gaza Water Resources Program."
- *Appendix B, List of Meetings and Site Visits* lists the key meetings and site visits undertaken by the evaluation team during the mission.
- *Appendix C, Mid-Course Workshop Report* summarizes the purpose, program, list of participants, key highlights and evaluation of the participatory workshop organized by the evaluation team on May 27 in Ar-Ram.
- *Appendix D, Round Table Report* summarizes the purpose, list of participants, key highlights and evaluation of the round table organized by the evaluation team on May 29 at the WBWD.
- *Appendix E, Comparative Costs of Small-Scale Water Infrastructure Projects* compares the total costs, as well as the breakdown of total costs into design, construction supervision, construction and management costs, for a selection of 10 small-scale water infrastructure projects implemented by US and local contractors and NGOs/PVOs.

RECENT AND ONGOING CAPACITY-BUILDING EFFORTS

Just as USAID and the international community (especially the Dutch and Norwegian programs) were looking to develop strong and autonomous water management institutions, the resources of PWA and municipal utility managers were exhausted by the economic crisis, limited mobility, and damages from military incursions. There is a broad consensus that fundamental changes are needed in the PWA, but that they are unlikely to get the necessary political and financial support in the current atmosphere of crisis. Most fundamentally, a reliable revenue stream for O&M will probably not recover while the current instability goes on. Nonetheless, the PWA maintains a vision of separating operational and management functions, and establishing regional water utilities. There are still opportunities to improve certain skills, and an increasing need to support routine O&M.

Capacity building for O&M has been an important component of USAID's water programs in the West Bank and Gaza. Significant efforts have been made, meeting with many successes, yet a number of difficulties as well. In addition, other donors have plans for helping to meet O&M needs in Palestine. This chapter presents recent and ongoing capacity building efforts implemented under water programs funded by USAID and other donors such as the French, Dutch-Norwegian and World Bank and highlights some of the key successes and difficulties of those efforts.

CAPACITY BUILDING UNDER USAID'S WATER RESOURCES PROGRAM

In Water Resources Program-Phases 1 and 2 (WRP1 and WRP2) in the West Bank, and the Coastal Aquifer Management Project (CAMP) in Gaza, USAID's activities in capacity building focused on simple operations and maintenance of the new infrastructure in the Bethlehem-Hebron area; development of a Joint Services Council (JSCs) for cooperative utility management in the Jenin Villages; and the development of modeling and aquifer monitoring expertise and performance of routine O&M in Gaza. Work under the Water Resources Program-3 (WRP3), now being completed, has also assisted the Palestinian Water Authority (PWA) and West Bank Water Department (WBWD) in technical operations and maintenance, financial and logistical management, strategic planning, and other institutional programs.

USAID implemented numerous institutional and technical capacity-building programs in Gaza through the Coastal Aquifer Management Program (CAMP), especially for PWA and Gaza municipality. A new Coastal Utility is to be established under World Bank auspices, but there is currently no institution comparable to WBWD. Instead, the municipalities own and manage water infrastructure directly.

O&M capacity building approaches have included technical support to O&M teams, training activities and workshops, equipment, and other support for bulk water supply and distribution facilities. In addition, some

large infrastructure projects serving clusters of villages, such as the Jenin 11 Villages water program, have O&M components.

HANDS-ON TRAINING

Field O&M staff have found hands-on training to be extremely valuable. These hands-on approaches have included "shadowing," or "twinning" of an international expert with one (or more) Palestinian trainee(s). This hands-on training activity at the actual facilities to be maintained can be valuable in its own right, and also can significantly enhance information imparted during workshops and classroom sessions. Hands-on training activities have included the following trainers and activities:

- Bill Taylor (CH2MHill), an experienced pump person, who spent about 6 months in-country;
- Bruce Contino (Montgomery-Watson), an electrical specialist, who spent about three months in-country;
- Virgil Norquist (CH2MHill), a pump expert who spent about six months in-country; and
- Bruce Soule (CDM), a civil engineer currently working in-country.

Training by these individuals has been of two basic types. Information is imparted by virtue of these consultants' work toward finalizing construction and starting up various pump station components. This activity includes direct interactions and training of O&M staff. In addition, shadow training has been used to help organize maintenance scheduling, diagnosis and repair. The success of hands-on training approaches depends strongly on the individuals involved (both trainer and trainees), and how it is set up.

Hands-on training has occurred during various repair work conducted by experts who are resolving various equipment issues, such as problems with the WRP1 submersible pumps. This training activity is on a more ad hoc basis than shadowing, yet it valuable to the extent that local O&M personnel are involved. For example, Bruce Soule of CDM is working with O&M staff to resolve pump and other issues, which helps support the O&M staff's planning and technical capabilities.

TRAINING COURSES AND WORKSHOPS

A number of training courses and workshops have been conducted to support O&M, including the following:

- Servicing submersible pumps (training in Jordan);
- Maintenance and repair training for vertical and horizontal booster pumps;
- Training WBWD Ramallah maintenance facility staff in Jordan and Kalandia;
- Operations training in Haifa and Akko, including electrical (VFD) training;
- Service rig operation; and
- Pipe welding inspection.

These training activities have been well received. The training on pump servicing was conducted for the O&M field team. This team consists of a team leader, an electrical engineer, a mechanical engineer, a controls engineer, and a water quality engineer. The leader of the O&M field team, Dr. Zeidoun, has not participated in

these training sessions; yet he does perform hands-on repair and maintenance. The training in Jordan for WBWD maintenance facility staff included use of machine tools such as lathes and drill presses. The service rig involves an entirely separate crew, which was trained on its operation and maintenance, and is led by a seasoned operator with several years of experience in the Gulf.

Other training on equipment has been provided. This includes training on how to use data loggers installed to monitor water levels in the wells. First aid and fire-fighting training was also provided. The pipe welding inspection training was used to the field O&M team with overseeing repair of transmission line breaks.

SOFTWARE TRAINING

Software training workshops have been conducted, focusing on the West Bank, and have included:

- Aquifer modeling;
- Hydraulic Modeling using EPANet;
- GIS; and
- MP2 software, a maintenance software package produced by Datastream Systems, Inc., based in Greenville, SC (work-order processing and record time-keeping).

The hydraulic modeling activity targeted training on hydraulic system design. GIS training focused on using the software, Arcview, as a means of keeping maintenance records at the well stations. The O&M field team has reported using the GIS system successfully for this purpose at four (WRP1) of the eight wells operated and maintained by PWA/WBWD.

EQUIPMENT

Equipment provided for building O&M capacity has included the following

- Well service rig;
- Maintenance center in Ramallah, and equipment for it (lathe, etc.);
- Small maintenance center at Izzariah 2 (parts and workbench items, computer with GIS software);
- Vehicles (3), laptops, printers;
- Spare submersible pump assembly; and
- Equipment for maintaining transmission pipe (backhoes, leak detection equipment).

These items have all contributed significantly to building O&M capacity.

OTHER O&M ACTIVITIES

Other O&M activities have included developing Standard Operating Procedures, manuals, and maintenance lists and interval schedules for the pump stations. Construction claims support was provided, along with help developing a well monitoring and reporting system.

A Performance Improvement Planning (PIP) workshop was conducted for PWA personnel, and help was provided with donor coordination through development of a database and encouraging donor coordination meetings, which were conducted by the PWA.

SUCCESSES OF O&M CAPACITY BUILDING ACTIVITIES

Overall, it is apparent that the approaches described above have made important strides toward building sustainable O&M capacities. Early needs assessments showed that equipment, staff, training, and financial resources were insufficient for maintaining WRP facilities. Since that time, significant improvements have been made.

Clearly, the well service rig has been extremely successful, permitting removal of submersible pumps from great depths and re-installing them without having to hire an outside contractor (typically Mekorot of Israel), saving money (over one hundred thousand US dollars each time) and time (several weeks of delay each time). One key characteristic of the well service rig is that its team leader is a senior, experienced person with many years of directly applicable experience gained in the Gulf.

Development of maintenance centers has also been successful. The small maintenance center at the Izzariah 2 pump station has helped with minor maintenance and repair at the well stations. The maintenance center in Ramallah, recently completed, is an important step toward building sustainable O&M capacity. Initial equipment has been installed, including a lathe, drill press, air compressor, and other items.

> Goals for the Ramallah Maintenance Center are commendable, and include developing equipment and know-how for small and large repairs, along with storage of spare parts, inventorying, and training. But those goals may be too ambitious and vague, and have yet to be clearly articulated.

Numerous other successes are of note. New O&M personnel, including the field O&M team, have been hired and have learned through training to operate the equipment and to perform basic maintenance procedures. While knowledge of more advanced maintenance procedures is growing, *the O&M field team has expressed the need for more training on how to maintain the WRP2 well stations*. Equipment provisions have buttressed record keeping and transportation, although travel restrictions imposed by controlling authorities are problematic, as discussed below. More advanced training on maintaining wells and on electrical components such as VFDs (variable frequency drives) has been useful, and has kindled greater interest in training, requests for which were often repeated during meetings.

DIFFICULTIES AFFECTING O&M CAPACITY BUILDING ACTIVITIES

Despite the successes outlined above, a number of difficulties have manifested themselves during O&M capacity building efforts. For purposes of this discussion, Table 1 has categorized these difficulties into organizational, structural, financial, personnel, and other issues not readily fitting into the other categories.

A number of organizational difficulties are apparent. The field O&M team is apparently on the PWA's roster, but is not on an organizational chart linking it to the WBWD. Job responsibilities are more or less understood, but job descriptions are not clearly developed, such that expectations are clearly set out for evaluating performance, for example. While basic maintenance schedules appear to be followed, there is not a clear plan for deciding which procedures are best performed by maintenance staff, which should be performed by an outside contractor, or which should be performed by the equipment's manufacturer. Neither is there a clear

vision of how such an O&M approach should evolve over time to accommodate goals for the Ramallah maintenance center. Equipment repairs are not always implemented quickly, and equipment from one station may be moved to another as a temporary expedient.

Also, each of the four engineers on the field O&M team discharges at least two very different functions: (1) technical related to O&M of well stations and (2) administrative and managerial related to supervision/scheduling of operators, GIS data entry, etc. for two of the eight new wells in the South. This allocation of tasks/functions may not be the best use of technical resources available to PWA/WBWD.

Structural problems include those resulting from access and travel restrictions, permit requirements for personnel, and restrictions on vehicle movement. In some instances, there have been problems getting equipment manufacturers' personnel to the sites. For example, it was reported that at the start of the Intifada, many equipment manufacturers' representatives left the area and did not return to help finalize construction at key milestones.

Financial difficulties are important factors influencing O&M capacity building. Lack of a specific O&M budget has contributed, at least in part, to a situation of dependence on outside aid for meeting many of the larger maintenance tasks. Resources are brought to bear in cases of transmission line breaks, when outside contractors are brought in to effect repairs. However, it is reported that such breaks do not occur at a high frequency. Thus, the extent to which finances can be mustered to effect repair of damage to significant equipment items is not known.

Some motivational issues have been noted among maintenance personnel. For example, it has been reported that when various settings or set-point changes are made, key maintenance personnel often do not make written note of the new settings. Some tension has been observed among the O&M team, which may result in part from frustration over lack of clear roles and responsibilities.

Table 1
Summary of Difficulties Affecting USAID's O&M Capacity Building Efforts

Organizational	Structural	Financial	Personnel	Other
• O&M Team is not on the WBWD organizational chart • Lack of short- and long-term planning for O&M, including how to interface over time with the maintenance center • Roles and responsibilities not clear (job descriptions); and associated accountability issues • Linkage to water resources group and aquifer modeling (for optimizing pumping operations) is unclear	• Access and transport problems • The PWA-WBWD relationship has yet to be fully developed • Difficulties getting key equipment and other personnel to travel to sites	• Lack of sufficient operating funds for the PWA and WBWD • Neither a separate O&M budget, nor financial accounting of expenditures	• Motivation among some O&M personnel is low, or not developed • Some tension exists between members of the O&M team • Expectations as to what must be done, when, and by whom need clarification • Unknowns (such as development of a National Water Utility) may be affecting employee morale	• Well stations not yet "accepted;" hence ownership not considered to be fully assumed • Long-standing well station equipment problems are still being addressed. Stations are not finalized. • As-built drawings not yet completed

Important difficulties stem from the fact that the WRP1 and WRP2 well stations have not been formally received by PWA/WBWD yet. In particular, the WPR2 equipment has yet to be formally accepted by PWA. Further, there is a constant dribble of equipment issues (submersible pump problems, impeller material problems, and the like) that are being addressed as construction problems and/or associated retrofits. This situation is confusing because it is not always clear who (the construction contractor, the manufacturer, or USAID's contractor) should repair and maintain what. This state of affairs is in part a result of the Intifada, which created difficulties with resolving construction issues with the well stations. Nevertheless, the situation must be resolved before the well stations can be declared finalized and ready to simply be operated and maintained. Only then can PWA/WBWD personnel have the full sense of ownership necessary for fully assuming responsibility for the stations, but nonetheless they need to plan for O&M in advance of receiving the stations.

Other O&M difficulties include the fact that full sets of as-built drawings have yet to be provided for the WRP2 well stations. Further, a number of factors are likely to be affecting employee morale, such as where their positions may fall (or not) after restructuring of WBWD to form a National Water Utility.

JENIN JOINT SERVICES COUNCIL

USAID funded the design and implementation of this project, which supplies potable water to individual households in 11 villages west of the City of Jenin. The project was completed in 2000 under WRP1. CDM designed the system, which includes the Jenin 2 well, booster station, reservoirs, transmission line, and village-

level distribution networks (secondary lines). CDM subcontracted the construction of the main water supply system (production well, reservoir, booster station, transmission line) to ABB Soussa.

USAID issued a separate Request for Applications (RFA) for the construction of distribution networks, institutional development of the Jenin JSC, and public awareness. The RFA led to two cooperative agreement awards: one to ANERA for construction of the distribution network in five villages, as well as institutional development of the Jenin JSC. The second award was to SCF for constructing the distribution network in the other six villages, and raising public awareness. Both ANERA and SCF subcontracted the design and construction supervision of the water distribution network to the Center for Engineering and Planning (CEP). CEP reviewed the design, specifications, and Bills of Quantities of CDM, putting them into a format and language compatible with local construction practices. To expedite the construction, both ANERA and SCF split the execution phase into two construction packages awarded to three different contractors (Gamma and Arar under ANERA and Gamma and Dar under SCF).

As noted above, ANERA provided institutional development support, including organizing and coordinating public meetings and workshops, leading to creation of the Jenin JSC. Initially, there was a plan to develop a Water User Cooperative. However, the 11 villages seized on the opportunity offered by the Ministry of Local Government's Law on Joint Services Councils to create the Jenin JSC.

The Jenin JSC was structured to have capabilities to manage, maintain, and expand the water distribution network (HDPE pipelines) at the village level. There are six operators, one manager, one full-time accountant, and two administrative assistants. Accounting is accomplished using Oracle-based software tailored for water management. New Jenin JSC technicians received on-the-job training at the Jerusalem Water Undertaking, which has years of experience with drinking water supply. Each dwelling unit has a water meter.

PWA shifted the responsibility for O&M of the upstream supply system—i.e., the transmission line (ductile iron pipe) and reservoirs, booster stations, and power generators, but excluding the well and its submersible pump -- to the JSC. However, the JSC may not have the technical or financial resources for maintaining booster pump stations. Various equipment items and capabilities are absent (e.g. certified welders and welding machines, etc.) The Jenin well, submersible pump, balancing tank and the booster station serving the Jenin City are the responsibility of the Municipality of Jenin.

SUCCESSES OF THE JENIN JSC PROJECT

Successes of the Jenin JSC water project are as follows:

- Formation of the Jenin JSC to move this project forward was by all accounts a significant success. Following the Israeli incursion into Jenin and the accompanying destruction of basic infrastructure, the JSC repaired the water distribution network at a cost of $60,000 using its own human and financial resources. This result attests to the sustainability of the JSC.
- The JSC has taken the initiative to tap alternative water sources to make up for the limited supply provided by the Jenin 2 well. It built a separate water supply system consisting of a balancing tank and pumping station to receive water from agricultural wells in the region and pump it into the Jenin JSC water system.

For example, the JSC purchases supplemental water from agricultural well owners at Kufr Dan for 1 NIS/cubic meter, especially in the summer.

- The Jenin JSC is willing to provide assistance to other small villages on O&M of their water systems, in the form of free training. They also are willing to maintain other villages' water distribution system on a contract basis.

- Jenin JSC operators worked directly with the contractors doing construction of the network. They were also trained in the O&M of the HDPE pipe by a specialist and at the Israeli factory where the pipe is produced.

DIFFICULTIES OF THE JENIN JSC PROJECT

Technical, institutional and financial difficulties of the Jenin JSC water project have been as follows:

- The JSC is ultimately dependent on the Jenin 2 well as the main source of drinking water. The submersible pump in the Jenin 2 well has broken down six times over the past 5 years. Maintenance of the Jenin 2 well, its submersible pump, and ancillary equipment (e.g., chlorination system) by the Municipality of Jenin is very poor.

- The JSC booster pumps have been removed from the Jenin well station for impeller replacement. Once this replacement is completed successfully, the booster pumps serving the JSC should work well provided they are properly operated and maintained by the JSC.

- Overall, booster station maintenance is not up to standard. JSC technicians need on-the-job training on the maintenance of booster pump systems, including electric panels. They also need a mobile maintenance vehicle equipped with necessary tools and parts for maintaining the system.

- Bill collection is at about 35 - 40% at present, down from 60 – 80 % before the Intifada.

- More technicians are reportedly needed; however, financial resources are insufficient to hire them.

- Water production from the Jenin 2 well is lower than anticipated. The Jenin JSC share of the Jenin 2 well's production is only 27 liters/capita/day, far below the water needs of the 11 villages.

- Villages can appoint somebody other than the head of the Village Council to represent them on the board of the JSC. According to the director of the JSC, Mr. Munir Jaradat, it would be better to have the heads of the local village councils on the JSC Board of Administration, because they are able to make binding decisions on behalf of the village councils they rerpesent.

- Because electrical transmission facilities are absent, the JSC depends on diesel generators to supply power at each booster station. This dependence on diesel generators requires special O&M attention with high cost implications (oil capacity of one generator is 400 liters) and downtime risks for repairs.

- There are difficulties finding water level sensors to replace the broken ones at the Rumanneh pumping station. Magnetic flow meters at this station are out of service. Neither the water sensors nor the flow meters have worked since the station was handed over to the Jenin JSC.

- Scale is forming in system piping.

- Lack of sufficient amounts of water supply makes it difficult to run the system automatically. Therefore, it is run manually, potentially reducing the life of system gate valves and bypassing significant investments in automated control equipment.
- There are water meter box and water meter difficulties. Water meter boxes are apparently of poor design and inappropriate material (e.g., workers get injured while trying to access meters). Magnetic meters (manufactured by Arad) can be more easily circumvented (using a magnet) than meters used at the JSU (manufactured by Kent). In addition, the Arad meters have other limitations: they must be installed horizontally (while the Kent meters can be installed in any direction), and they do not have non-return valves, which allows them to be run in reverse (which again is not the case with the Kent meters).
- Spare HDPE parts are not available locally, and are difficult to obtain.

FRENCH TECHNICAL ASSISTANCE TO WBWD

The objective of the ongoing French technical assistance to WBWD is to "Strengthen the management, develop technical capacities, and help define and set up an adequate institutional, organizational, and management for the production and transport of bulk water in Palestine." This project focuses on two aspects: (1) institutional/organizational and (2) capacity building for O&M.

The institutional/organizational component is concerned with creating by 2005 a National Water Utility (NWU), responsible only for bulk water supply. This effort is examining various mechanisms for defining, creating and running a NWU, including different combinations of governmental and private sector participation. The ministries of Finance, Justice, and Agriculture are involved in developing the legal mechanisms for creating this NWU. A Human Resources Development Plan will be developed, with an accompanying training program.

The O&M capacity building component includes funds for organization, training, and select equipment. The organizational component of the effort includes helping arrange for a private laboratory to perform water quality analyses. In addition, a Computerized Maintenance Management System (CMMS) will be developed using the MP-2 software package already on-hand. The bulk water infrastructure will be inventoried and entered into the CMMS, along with information on its condition and recurring costs. Then, the CMMS will be used to create an O&M budget that is separate from that of the Palestinian Authority, with a goal of self-sufficiency for the new utility. A Computerized Consumer Management System (CCMS) also will be developed to aid with tracking the new utility's finances.

The French TA program will include providing leak detection and bulk meter testing equipment to the maintenance facility in Ramallah. The goal of this project component is to help reduce water wastage by fixing leaks and improving the accuracy of water metering. Some funds may be available from a French emergency equipment fund for material for leak repairs.

The French program will include performing a study of a Supervisory Control and Data Acquisition System for the bulk water system, which will prepare the Terms of Reference and specifications for such a system. Although a cost estimate will be prepared, no funds will be provided for this SCADA system.

DUTCH-NORWEGIAN TECHNICAL ASSISTANCE TO PWA

The program is termed "Institutional Capacity Building of the PWA," or "Budget Support of the PWA." This assistance is the third of three phases. The first phase involved the Norwegians alone, while the Dutch joined at about the mid-point of the second phase. This third phase began May 2003 and will end in December 2005.

This assistance focuses on helping the PWA meet structural requirements of the Palestinian Water Law, which has eight objectives. One objective relevant to water operations is for PWA to ultimately be a regulatory body only. Preliminary versions of related regulations have been drafted, but without much detail. For example, PWA staff members' roles have not been defined. Future steps toward codifying PWA's regulatory role include developing compliance and reporting requirements for water utilities.

The Dutch-Norwegian TA also focuses on reforming delivery of water services. This effort entails defining the relationships between PWA and WBWD, the Jerusalem Water Undertaking and nearby municipalities, water vendors, and other water sector entities. The approach includes clarifying resource allocations, water abstraction licensing, water tariffs, and performance control and quality assurance of water providers.

This TA also will develop a water tariff model that would be used by PWA to review proposed tariff changes by service providers to ensure that customers are protected and that profits are not unreasonable. In addition, approaches for contracting, design, implementation and handover of infrastructure are under development, helping PWA control project quality. These ideas are all at very preliminary stages of development.

PWA exercises a high degree of control over this technical assistance. Program operating funds have been provided directly to PWA through the Ministry of Finance, enabling PWA to do its own procurement and consultant hiring. The Dutch-Norwegian team monitors the effort. While this direct funding approach can be effective, it is reported to be rather slow to achieve results. Nevertheless, the Dutch-Norwegian team believes that there has been reasonable progress in recent years.

WORLD BANK TECHNICAL ASSISTANCE

The World Bank has developed a $13.4 million water project with both infrastructure and capacity building components in the West Bank. The overall project objective is to increase potable water supplies, thereby reducing health risks. In addition, the project aims to reduce water costs and system losses. This assistance has been conceived in conjunction with other water sector investments that are coordinated by PWA.

The infrastructure component of the World Bank assistance consists of three packages. One package will increase by 200 cubic meters per hr the production from the East Herodian No. 2 well (south of Bethlehem), along with conveying water from that well to the main north-south transmission pipeline. The second package includes transmission and storage facilities to serve Kharas and Nuba villages as well as villages west of Hebron. The third package will rehabilitate water distribution networks in Kharas and Nuba villages, with complementary funding from USAID.

The capacity building component of this assistance focuses on strengthening the Project Management Unit (PMU) within PWA to implement the project. Part of the operating costs of the PMU will be financed during the effort, which will include working with other donors to develop joint service council clusters. These JSC

clusters will maintain and operate the water distribution networks at the retail level. In addition, the World Bank will finance technical support services by consultants for design, preparation of bidding documents, and construction management.

NEEDS AND OPPORTUNITIES FOR BUILDING O&M CAPACITY

Many ideas for building O&M capacity arose during the course of the evaluation. In many instances, these ideas/approaches build on previous or on-going efforts toward sustainability of water sector infrastructure in the West Bank. While some approaches are quite feasible and necessary, others may not be due to financial and/or other constraints. This chapter presents a range of approaches to build capacity for O&M of the water infrastructure in WBG and concludes with recommendations for future action. Chapter 4 discusses, *inter alia*, the O&M capacity building needs and opportunities specific to small-scale water infrastructure.

BULK WATER SUPPLY

This section discusses issues pertaining to O&M capacity for the bulk water supply system owned and operated by PWA/WBWD, and accompanying needs/opportunities for enhancing this capacity. For purposes of discussion, these issues and associated needs/opportunities are divided into "soft" (non-equipment technical assistance) and "hardware" (equipment) categories. Appendix C (Mid-Course Workshop Report) and Appendix D (Round Table Report) provide detail on the needs and opportunities for O&M capacity building in the water infrastructure in WBG as viewed by the participants in these two key meetings. The evaluation team has taken those views into consideration in the analysis presented next.

SOFT ISSUES AND OPPORTUNITIES

As listed in Table 2, the key soft technical assistance issues for bulk water supply systems and needs/opportunities for addressing them are as follows:

1. Communications and teamwork;
2. Roles and responsibilities for O&M;
3. O&M planning needs and opportunities;
4. Weaknesses in the capabilities and competencies of the operators;
5. Administrative/management functions add unnecessarily to technical personnel's responsibilities; and
6. Training needs and opportunities.

Table 2
"Soft" Issues and Opportunities for Building O&M Capacity for Bulk Water Supply Facilities

Issues	Needs/Opportunities
• Lack of communication and teamwork within/ among the field O&M team, the O&M and management team of WBWD, and the team of technicians at the Ramallah Maintenance Center	• Team-building aimed at creating/reinforcing professional attitudes about work, developing mutual trust among team members, reaching common understanding of goals and objectives, etc. as a prelude to clarifying respective roles and responsibilities
• Roles and responsibilities are unclear	• Develop job descriptions & the organizational chart for all teams (O&M team, Maintenance Center team, service rig team), including linkages, reporting channels, etc.
• PWA/WBWD and O&M field team do not have a clear, written O&M plan for the bulk water supply system, including the Maintenance Center in Ramallah • There is no bona fide Preventive Maintenance program • WBWD and O&M field team do not have a good appreciation of what they can realistically repair in-house versus what they must outsource	• Develop an O&M plan (to include a Preventive Maintenance Program) through an appropriate sequence of planning steps, integrating O&M planning with that of the maintenance center in Ramallah
• Weaknesses in the capabilities and competencies of the well station operators	• Develop training programs targeted at the well station operators
• Field O&M team is comprised of five male engineers who are tasked with administrative and management functions that are better done by others (e.g., GIS, management of operators)	• Organize and clarify management and administrative functions as separate from technical functions within the future O&M department – Encourage the participation of female professionals in both the technical and management/administrative O&M functions
• Field O&M team believes it has insufficient capabilities for maintaining the WRP2 stations	• Training on maintenance of basic WRP2 well station systems, and on maintenance planning and prioritization, through shadowing/twinning, using experts on-site for extended time periods • Formal training, both hands-on and classroom
• Operation of the integrated WRP1 and WRP2 well stations requires a better understanding of the integrated hydraulic system	• Improve hydraulic modeling approaches
• Different types of equipment used in different stations, requiring more diverse O&M capabilities and skills	• Build a knowledge base of equipment utilization and experience – Try to standardize equipment use in future water projects
• Lack of inventorying system at the Maintenance Center in Ramallah	• Develop inventorying capabilities in coordination with the French TA program, in particular the future Computerized Maintenance Management System

COMMUNICATIONS AND TEAMWORK

It is apparent that there is a lack of communication and teamwork between/among the field O&M team (Dr. Zeidoun and the O&M team of four engineers), the management and O&M team of WBWD (Eng. Mohammad Jaas, Eng. Ibrahim Ayesh, and Eng. Thabet Hmayel), and the team of technicians being developed for the Ramallah Maintenance Center. This lack of communication manifests itself in a number of ways. For example, there appears to be some reluctance on the part of the field O&M team to speak their mind up in front of the Team Leader, Dr. Zeidoun. This lack of trust and communication may be attributed, at least in part, to issues discussed below, such as absence of clear job descriptions. Nevertheless, implementing solutions for tackling this lack of communication and teamwork is important. These approaches include teambuilding to enhance the

willingness and ability of team members to communicate effectively as a prelude to improving their working relationship and eventually their performance, both individually and as a team.

ROLES AND RESPONSIBILITIES FOR O&M

Roles and responsibilities are not clear, as illustrated by lack of an organizational chart showing the O&M team. Thus, there is an absence of clear lines of authority and accountability, exacerbating communications problems. Developing clear job descriptions and an organizational chart for the O&M field team, and showing linkages to the other teams such as the Maintenance Center team, the oil service rig team, and PWA/WBWD management, would go a long way in addressing those difficulties.

O&M PLANNING NEEDS AND OPPORTUNITIES

WBWD needs to be able to develop and implement its own O&M plan. O&M planning opportunities arise from the absence of a clear, written O&M plan for the bulk water supply system. Maintenance team members do not have a clear picture of how to integrate basic preventive maintenance with testing and repair procedures, nor do they understand fully which procedures are appropriate to their level of experience. It is commendable that the O&M field team is enthusiastic about taking on virtually any maintenance or repair. However, it needs to be recognized that this approach is not feasible at the present, and may not even be desirable in the long run (may not be cost effective).

This O&M planning approach should include development of a bona fide preventive maintenance program and address larger issues as well. For example, the team has brought in Caterpillar personnel to diagnose and repair problems with diesel generators. Likewise, there are experts on other plant components and systems, such as electrical experts, who can and should be brought in at key junctures. Such visits by specialists are opportunities to learn and to build up a knowledge base so that diagnostic and other procedures applied by these outside experts can be replicated by the appropriate team members in due course. Specialists can be brought in both on a systematic basis (at frequencies recommended by manufacturers and consultants for equipment check-out or calibration, for example), and on an ad-hoc basis (when equipment failures occur).

Further, there is a need for integrating O&M activities with the Ramallah Maintenance Center. For example, the Maintenance Center has been supplied with a lathe, which can be used for a variety of purposes, such as machining various pump parts. Nevertheless, such procedures cannot be begun at once, but must be integrated over time into the staffs' repertoire through further training, practice, and experience. Thus, it is important to include such approaches as part of the O&M planning process, laying out for each major equipment item (or system, as appropriate) which procedures and repairs should be performed by:

- The O&M field team on-site;
- An outside contractor (such as an experienced electrician);
- WBWD O&M staff at the Maintenance Center (now, or later); or
- The equipment manufacturer.

The O&M planning process should take an integrated approach, including approaches for increased self-sufficiency over time.

There may be opportunities for linking aspects of developing a comprehensive O&M plan to the French Technical assistance effort discussed in Section 2.3. This effort includes a Computerized Maintenance Management System (CMMS) for all bulk water supply equipment, along with estimates for recurring O&M requirements and associated costs. Approaches for incorporating components of the O&M plan into this CMMS merit exploration. As discussed below, the O&M field team already has incorporated some aspects of CMMS planning into its GIS system. Building the CMMS should build on those efforts by the O&M field team.

Note also that Mr. Mohammed Jaas has indicated a desire for postponing USAID O&M planning efforts until the French TA has further evolved. This issue should be clarified in terms of donor coordination efforts.

WEAKNESSES IN THE CAPABILITIES AND COMPETENCIES OF THE OPERATORS

Members of the O&M field team have indicated that the operators, who staff the well stations twenty-four hours per day, have weaknesses that they (the O&M team) would like to address. This need/opportunity can be addressed by developing training programs for operators, incorporated into the O&M planning process described above, and/or as part of "train the trainer" approaches developed for the O&M team.

ADMINISTRATIVE/MANAGEMENT FUNCTIONS ADD UNNECESSARILY TO TECHNICAL PERSONNEL'S RESPONSIBILITIES

As mentioned previously, the four members of the field O&M Team (excluding the Team Leader) have administrative and management functions that should be performed by others. For example, each engineer is assigned the responsibility for operator scheduling at two well stations. In addition, these engineers must enter operations and maintenance data into the GIS system used for handling this information. It would make more sense to let other staff handle those functions to allowi the engineers to focus on technical O&M issues. This issue is an opportunity for clarifying, separating out, and organizing management and administrative functions within the future O&M department.

TRAINING NEEDS AND OPPORTUNITIES

A number of issues tie to training needs. The O&M team believes that it has insufficient capabilities to maintain the WRP2 stations, because they are more complex than those developed under WRP1. For example, motors at the WRP2 well stations use variable frequency drives. Given this assessment, more training on these and other WRP2 systems is important, but should coincide with O&M planning in terms of outsourcing and phasing in in-house repair approaches.

Another indication of training needs is reflected in the O&M staff's assessment of a water hammer problem they are experiencing. Water hammer is developing when some check valves close and pumps shut down quickly during power failures. This is a common hydraulics problem that normally does not need to be studied using a software approach, as some WBWD staff have suggested. Nevertheless, the severity and frequency of this water hammer should be investigated to determine whether and how soon a solution should be implemented --probably through installation of a different type of check valve. Thus, there is an opportunity for practical training in hydraulics, especially on the topic of water hammers.

Training approaches for addressing these issues include shadowing/twinning using onsite experts for extended time periods as well as formal training, both hands-on and classroom. The training should be carefully planned and integrated with the O&M planning process discussed above. It is important that training events be commensurate with the background of the trainees as well as their roles and responsibilities. For example, only the electrical engineer (and perhaps the mechanical engineer and Dr. Zeidoun) would benefit most from advanced training on of variable frequency drives (VFDs).

Other training needs/opportunities are apparent. It has been noted that there may be a need to examine the hydraulic integration of the WRP1 and WRP2 systems. This step ought to have been taken by the design engineers. Nevertheless, it will behoove the operators to ensure that they understand any system limitations and means for optimization, which can be revealed through hydraulic modeling approaches.

There is an opportunity to implement an inventory system for the bulk water system, including the parts storage facility at the Maintenance Center in Ramallah. Inventorying can address the issue of standardizing bulk water system equipment, as it presents an opportunity for developing a knowledge base of equipment utilized, and experience with such equipment. Inventorying approaches are best integrated with the French TA planning for a Computerized Maintenance Management System, which is described in more detail in Section 2.3.

HARDWARE ISSUES AND OPPORTUNITIES

Issues pertaining to "hard" (equipment) needs/opportunities for building O&M capacity for bulk water supply are summarized in Table 3 and are discussed below.

Circumventing travel restrictions imposed by checkpoints and the accompanying restrictions on staff travel between some areas will continue to require creative approaches. One approach is to develop a Supervisory Control and Data Acquisition System (SCADA) for remote monitoring and control of the well stations. As discussed in Section 2.3, the French TA project will develop a preliminary design and TOR for a SCADA system for the bulk water system. Thus, there are opportunities for coordination between USAID and the French TA project on this approach. SCADA approaches are discussed further in the next section.

Other opportunities for addressing travel restriction issues include establishing a maintenance center in the south to house basic repair tools and parts. There is also a lack of basic electronics testing equipment accessible in the south, which can be addressed by providing basic electronics testing equipment as a part of this southern center. Further, two vehicles for the south, one with a yellow and one with a green plate, can be based at this center. To help maintain the cluster of wells in the south, the yellow plated vehicle can be a fully equipped maintenance truck with standard tools and frequently used spare parts.

There is a need for being able to fully test the deep well and booster pumps to determine repair needs and verify efficacy of repairs. Pump testing equipment (a pump test bench) can be placed at the southern maintenance center discussed above, so it can be determined where to route a defective pump (either to the maintenance center or to Haifa, for example). Alternatively, a pump test bench can be installed near the maintenance center in Ramallah (there is not room left at the center to add a pump test bench).

Other issues present opportunities for building the hard side of O&M capacity. Full capabilities (that need to be defined as part of developing an O&M plan) for the Ramallah maintenance center are an issue that can be

addressed by adding the appropriate equipment to that which has already been made available there. O&M staff need an appropriate set of cranes, winches and platforms for removing and reinstalling heavy equipment items. Communications issues can be addressed through mobile telephones with walkie-talkie functionality. Computer equipment used by O&M staff can be enhanced to address issues associated with downloading well logger depth data, and use of the GIS system for recording maintenance information.

Provision of another well service rig would increase capabilities for removing and installing deep well pumps, especially in light of prevailing travel restrictions.

Also, the O&M Team Leader has repeatedly voiced his concern that the team lacks diagnostic and other equipment on which the O&M staff have been trained (e.g., in Jordan). He argued that the O&M team should not be trained on the use of equipment if such equipment will not be made available to them. Providing specialized maintenance equipment, and training on its use, must be consistent with the scope of the repairs to be done by WBWD (O&M field team, Ramallah Maintenance Center, etc.), as outlined the O&M plan described previously.

Table 3
Hardware Issues and Opportunities
for Building O&M Capacity for Bulk Water Supply Facilities

Issues	Needs/Opportunities
• Problems accessing well sites due to travel restrictions	• SCADA (coordinate with French TA) • Providing two vehicles for the south with different plates (yellow and green); the one with yellow plates can be a fully equipped maintenance truck with standard tools and frequently required spare parts
• Ready availability of maintenance materials (spare parts) and tools for the bulk water supply system in the south	• Establish an O&M center in the south, and one in the north for maintaining the Jenin 2 well station
• Lack of facility for basic electronics testing accessible in the south	• Include an electronics testing facility at a southern O&M center
• Need for fully testing pumps, which are primarily in the south at present, to diagnose repair needs	• Supply a pump test bench, strategically located for optimizing repairs either in-house, or out-sourced
• Full capabilities (that need to be defined as part of developing an O&M plan) for the Ramallah maintenance center	• Purchase, install, train, and practice on the appropriate equipment
• Lack of capacity for removing booster pumps and motors	• Supply an appropriate set of cranes, lifting winches and platforms
• Inadequate facilities for communicating among O&M team members, and with operators	• Supply mobile phones with walkie-talkie functionality
• Lack of ability to download data from well loggers	• Laptops for downloading data loggers, data analysis
• Very slow access to GIS system on Pentium II computer	• Desktop for GIS
• High frequency of deep-well submersible pump breakdown	• Retrofit all submersible pumps • Provide a second well service rig
• Lack of diagnostic and other equipment that staff have been trained on	• Provide this equipment, as appropriate to the level of repairs expected

SUMMARY OF KEY RECOMMENDATIONS FOR O&M CAPACITY BUILDING

Based on the analysis presented in this section, the evaluation team proposes the following key recommendations to help ensure the sustainability of the bulk water supply system in the West Bank:

1. FINALIZE BULK WATER PUMP STATION CONSTRUCTION ISSUES TO ENABLE THE RECEIPT OF WORKS BY PWA/WBWD

It was reported to the evaluation team that means for correcting the submersible pump problems have been developed, including retrofits involving pump thrust bearings and shrouds. Nevertheless, the submersible pump that failed (on or about 28 May 2004) at Izzariah 3 had apparently not been retrofitted. It is important to learn the true retrofit status of these pumps and to perform/complete them as necessary.

In addition, a schedule for regular removal, inspection and testing (and repair, as necessary) of the deep well submersible pumps should be developed. This schedule should be based on actual operating and repair histories of these pumps, in consultation with pump experts including mechanical/pump engineers (not sales engineers) employed by the pump manufacturer. Removal during the winter months, when water consumption is lowest, can be factored into this scheduling. As necessary, spare pumps should be on-hand (tested and warranted) and ready to replace those that are removed for inspection, testing, and repair.

All other relevant pump station issues should be resolved with the objective of fully commissioning and handing over the appropriate entity(ies) (PWA, WBWD, and/or National Water Utility).

2. HIRE AN EXPERIENCED, SENIOR PUMP STATION O&M SPECIALIST TO OVERSEE THE OPERATIONS AND MAINTENANCE OF THE BULK WATER SYSTEM

This senior O&M specialist must have several 10 years of proven experience in the O&M of similar bulk water supply systems or equivalent. As discussed previously, the well service rig team is successful in large part due to the leadership and experience of its team leader. This approach should be taken for the well stations, as well.

3. CONDUCT TEAMBUILDING AND DEVELOP ORGANIZATIONAL CAPABILITIES, INCLUDING GENDER BALANCED STAFFING AND APPROACHES

Addressing the lack of communication and teamwork within/between the field O&M team and the WBWD team is important. This will require teambuilding to enhance the willingness and ability of O&M staff and management to communicate effectively as a prelude to improving their working relationship and eventually their performance, both individually and as a team. This teambuilding activity also should be accompanied by a parallel activity to develop an organizational chart and job descriptions for all O&M staff. Both activities must encourage gender-balanced staffing and approaches in this vital sector.

4. DEVELOP AND IMPLEMENT AN O&M PLAN THAT PROVIDES FOR TRANSITIONING FROM OUTSOURCING OF REPAIRS TO DOING SOME REPAIRS IN-HOUSE AND INCLUDES "TRAINING FOR RESULTS" AND TARGETED PROCUREMENT OF EQUIPMENT AND SPARE PARTS

This plan must be realistic and should include defined, agreed-upon milestones. At the outset, a careful listing (in writing) of repairs that are outsourced at present (such as pump reconditioning) should be developed,

including outside expert contractors (such as consulting engineers, local electrical contractors, etc.) for this outsourcing.

Realistic milestones for transitioning to performing certain repairs in-house must be developed in consultation with experienced professionals familiar with the systems to be maintained. Each planning milestone should have an attached listing of both diagnostic and repair equipment necessary for its accomplishment, as well as training needs. Milestones should be developed for both the O&M staff and staff at the Ramallah Maintenance Center. Only after this process has been carried forward should large equipment items, such as a pump test bench, be considered. A preventive maintenance program should be set up as part of this plan.

The Ramallah Maintenance Center needs to become fully operational before additional investments are made in similar maintenance facilities in the North or in the South. This will require achieving a certain level of organizational development and O&M planning capabilities. However, as explained in Section 4.8, the team recommends setting up two regional warehouses (spare parts, small equipment and repair tools), one in the North and one in the South, to provide quick-response capability for repair and maintenance of small water infrastructure in each region. These regional warehouses could become over time the nucleus of the future Regional Maintenance Centers. Also, establishing a laboratory in the South to house basic electronics testing equipment as well as basic repair tools and parts may be necessary in the short term.

5. SEPARATE O&M OF THE WELL STATIONS FROM O&M OF THE BULK WATER TRANSMISSION SYSTEM

Repair of transmission mains should be performed and overseen by a different group of individuals than those charged with maintaining the well stations. The skill sets for these two functions are entirely different. The transmission team should meet any needs for repair of piping at the pump stations.

6. ADDRESS TRAVEL AND ACCESS DIFFICULTIES

This includes providing two vehicles for the south, at least one of which shall have a yellow plate; the vehicle with a yellow plate should be a fully equipped maintenance truck with standard tools and frequently required spare parts.

7. WEIGH CAREFULLY THE IMPLICATIONS OF IMPLEMENTING A SCADA SYSTEM

Planning for a SCADA (Supervisory Control and Data Acquisition) system for the bulk water supply wells (WRP1, WRP2, and future wells) would help the WBWD meet is goal of reducing the number of sleeper operators. At the same time, however, one must recognize that staffing the stations twenty-four hours per day adds a measure of security, helping deter vandals while also helping prevent catastrophic equipment failure. In addition, the systems already have a level of data acquisition (well loggers, run-hour meters, etc.) and some controls are automated.

In any case, the goals of having a SCADA system must be carefully laid out, including considering exactly what would be monitored, what would be controlled, and why. Other questions that must be carefully considered include who would maintain a SCADA system and whether they would have the resources to do so. This matter is of some concern for the present because it was mentioned during the evaluation that there are plans for implementing a SCADA system at new wells constructed under the future WRP4.

8. BUILD ON THE COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM TO BE DEVELOPED WITH FRENCH TA

The French technical assistance program will develop a Computerized Maintenance Management System (CMMS) for all bulk water supply equipment, along with O&M requirements and costs. WBWD should build on this CMMS to improve the technical and financial performance of the O&M team.

Implementation of the MP2 software program for setting up a Preventive Maintenance (PM) program should be postponed until there is a careful investigation of actual maintenance scheduling and record-keeping needs. First, a PM program for each well station should be developed, and then these individual programs should be combined so that weekly and monthly PM tasks can be scheduled, and then recorded when they have been performed. Over time, the CMMS, which shall developed using the M2 software, may be brought into use for scheduling regular maintenance, but this step should be taken only after the details of the PM program are worked out and put into place. A basic PM program can be worked out using a spreadsheet or database.

9. PROVIDE BASIC REPAIR AND MAINTENANCE EQUIPMENT

Basic lifting cranes, frames, winches, and the like should be provided for helping O&M staff remove and reinstall equipment.

10. DEVELOP CAPABILITIES TO ESTIMATE AND MONITOR THE SHORT- AND LONG-TERM YIELDS OF THE NEW DEEP WELLS (AND OTHER WELLS, AS APPROPRIATE) UNDER ANTICIPATED OPERATING SCENARIOS

Actual well yields are reported to be below predictions. Therefore, this is not a training recommendation, but for a study (although water resources engineers from PWA/WBWD should be involved in formulating and conducting the study). At least one of the PWA/WBWD engineers involved should have a master's degree in hydrogeology, and several years of experience in groundwater modeling. Results should be presented as ranges, and the sensitivity of the predictions to different assumptions (hydrogeologic, allowable withdrawals under different political scenarios, etc.) should be part of the study.

New well stations are currently being designed under WRP4. Reviews by PWA/WBWD and O&M staff should begin early in the design process, with a preliminary engineering design report that focuses on the basis of design, design alternatives and a design recommendation; key equipment, including manufacturer, performance characteristics; controls in the form of a draft P&ID (process and instrumentation diagram); and a cost estimate. In addition to being reviewed by PWA/WBWD and O&M staff, the preliminary design report should be reviewed by a third party engineering design firm, using Value Engineering approaches.

As appropriate, aquifer and well-field modeling should be tied to modeling of the distribution system. The objective of this approach is to optimize utilization of the different wells, through recognizing how flow rates and system pressures will vary under different operating scenarios.

RECOMMENDATIONS FOR FUTURE

WATER INFRASTRUCTURE PROJECTS

Drawing on its observations during the three-week mission, the evaluation team has the following recommendations for future bulk water infrastructure projects in WBG:

1. Require the review of preliminary design alternatives by relevant parties and outside experts (see box);
2. Use equipment manufacturers whose representatives can and will come as necessary to WBG for installation, training, and follow-up;
3. Keep projects as simple as possible: e.g., use mechanical water level gauges on reservoirs where possible, feed liquid chlorine instead of gas (although the former is likely to be more expensive), keep operations manual if automated operations would be hindered due to local conditions (e.g., interruptions in water flow due to insufficient water supplies);
4. Conduct lessons-learned workshops with the participation of water engineering consultants and utility practitioners from throughout WBG with the objective of learning what has worked best under local conditions, and also what has not worked so well and what needs to be done about it; and
5. Incorporate O&M planning needs from the outset of a project. This includes ensuring from the outset that staffing will be sufficient; as well as budgeting for development of training implementation plans, delivery of training itself, and follow-up.

DEVELOPING SMALL-SCALE WATER INFRASTRUCTURE

The violence and closures of the past three years have delayed the development of large water infrastructure and focused attention on the repair, construction and maintenance of local infrastructure. USAID has implemented small water infrastructure projects in WBG through different mechanisms. Though individually fairly modest, in the range of $50,000 to $1,000,000, the cumulative investment is approximately $20,000,000. The underlying programs used by USAID to implement such projects were variously created for water resources development, emergency response, community development, or NGO development –but not specifically for the development of small-scale water infrastructure. The projects have ranged from the ad hoc to strategically planned elements of long-term programs. These projects also have varied in technical complexity.

The diversity of activities and mechanisms used to date is confusing for USAID, and for the beneficiaries. The normal trade-offs between faster, better, and cheaper are accentuated by security restrictions on USAID travel to project sites. Moreover, it is unclear what situations demand international expertise for design, construction management, or project oversight. To alleviate this confusion and streamline investments in small-scale water infrastructure, USAID intends to implement small-scale water infrastructure projects in WBG over the next few years as part of one dedicated program. To help USAID choose the best mechanism(s) to implement future small-scale water infrastructure programs, this chapter presents the potential pros and cons of different possible mechanisms. The chapter begins with an overview of possible mechanisms that have been used (or that could be used) by USAID to implement small-scale water infrastructure.

KEY LESSONS LEARNED FROM RECENT SMALL WATER INFRASTRUCTURE PROJECTS

The evaluation team visited a selection of small-scale water infrastructure projects in the West Bank and met with the beneficiaries, implementing partners (PVOs and contractors) and operators (village councils or joint service councils) of those projects (see Appendix B). Based on those visits and meetings, as well as the brainstorming sessions and discussions held at the mid-course workshop in Ar-Ram and the WBWD roundtable in Ramallah, the evaluation team made the following observations:

1. The need and demand for small-scale water infrastructure projects in WBG is likely to continue in the foreseeable future, even assuming an end to violence and closures;
2. In some instances, water construction projects implemented under Cooperative Agreements using local NGOs and contractors have not met basic construction quality standards;

3. Most small-scale water infrastructure projects are implemented without paying much attention to the basic requirements for ensuring the long-term durability of the infrastructure;

4. It may not make economic sense to build the individual capabilities of small municipalities and villages to undertake basic O&M of basic water infrastructure, such as repairing water pipelines and replacing water valves, let alone slightly more complicated equipment such as small booster pumps; and

5. More needs to be done to disseminate and build upon the skills and knowledge of local Palestinian "utilities," such as the Jerusalem Water Undertaking and the Jenin Joint Services Council, in order to incorporate the lessons learned from the Palestinian experience into the planning, design, implementation and O&M of future small-scale water projects.

The remainder of this section provides more detail on each of those observations.

NEED AND DEMAND FOR SMALL-SCALE WATER INFRASTRUCTURE

The small-scale water infrastructure investments made in recent years have helped address either basic and/or urgent water supply needs in urban neighborhoods, small municipalities and villages throughout the West Bank and Gaza. As explained in the introduction to this chapter, many of those investments were made in response to emergency needs resulting from violence and closures. Others were made to fill basic demands for water supply where none existed previously, such as by building filling points to supply water to villages without public water supply (e.g., Jalameh, Beit Dajan, Awarta), to rehabilitate or upgrade existing systems (e.g., rehabilitate old/leaking water networks in urban neighborhoods in Nablus, additional water supply connection to Mekorot and more elevated reservoir in Markeh).

In 2003, using the Jalameh filling station, the Village Council of Jalameh bought about 54,000 m3 of drinking water from Mekorot and sold this water to private water tank truckers and NGOs –CARE alone bought 19,000 m3 under an emergency water supply program funded by USAID-- who supplied water to unserved villages northeast of Jenin. The Village Council owns and operates the Jalameh filling station and is able to recover its operating costs (with minimal surplus if overhead costs are not factored in).

Demand for small-scale water infrastructure is likely to continue in the future, even assuming an end to violence and closures. During a brainstorming on "the most pressing needs in the water and sanitation sector in Palestine today" at the mid-course workshop held in Ar-Ram on May 27 (see Appendix C), the participants said the following in connection with *small* water/sanitation infrastructure needs:

- Develop new or alternative water sources for the 200 villages not served in WB
- Develop small WWT Systems for reuse in irrigation
- Improve water quality in rural areas
- Upgrade existing agricultural wells to support drinking water
- Improve water networks in Palestine [could be both large and small]

- How to get more water to satisfy future needs [could be both large and small]

In the West Bank alone, 200 villages reportedly lack public water supply. In addition, existing water distribution networks in several towns and villages are old, leading to high levels of Unaccounted for Water. Interestingly, there appears to be a consensus that the time may have come to invest in small/rural wastewater treatment and reuse systems, especially in light of the difficulties associated with siting and implementing large wastewater treatment plants (e.g., for Hebron).

Agricultural wells, mostly drawing on shallow aquifers in the North of the West Bank, are routinely used to provide drinking water by tanker trucks to rural communities deprived of public water supply. For example, the Jenin JSC buys water from agricultural well owners (farmers) in the area to supplement water supplied from the Jenin 2 well. The quality of this water and its suitability for drinking purposes are not properly monitored or controlled.

QUALITY OF CONSTRUCTION WORKS IMPLEMENTED UNDER COOPERATIVE AGREEMENTS

Although USAID has done nearly $50M worth of construction work through PVOs (primarily under the Community Services Program), several people interviewed by the evaluation team have expressed reservations about awarding construction jobs to PVOs. PVOs excel in assessing local needs, mobilizing local communities, building relationships of trust with them and developing local capabilities to operate and manage local development systems. In contrast, and unlike engineering and consulting firms, PVOs are not in the "construction business" per se and managing construction works is not within the mission statement of most PVOs. This is not to say that PVOs cannot manage construction projects, especially small ones such as developing or rehabilitating basic water networks in rural areas. Successful examples of such projects abound in WBG, such as the water distribution networks build by ANERA and SCF in the 11 villages west of Jenin.

In fact, most PVO representatives interviewed concede that PVOs should not take on the construction of larger or more complex water infrastructure projects, such as main pipelines (under pressure), water wells, especially deep ones, large pumping stations, and large water reservoirs. There is less consensus, however, about where to draw the line between small and large, and more generally between projects that the PVOs could implement successfully and those that should require the supervision and oversight of a specialized engineering firm. The case of the Tarkoumiah reservoir (capacity 1,000 m3) and pipeline project is quite revealing in this respect. Under a Cooperative Agreement with USAID, an international PVO built this reservoir a year ago by subcontracting the project to a reputable local NGO. The evaluation team observed two major deficiencies during a visit to the reservoir/pipeline site:

1. Several cracks have formed in the circular concrete wall of the reservoir, as evidenced by the trail marks left by water leaking along several spots on the wall (the reservoir was empty during the visit) and

2. A valve on the pipeline built from the main to the reservoir had been broken (or vandalized) several weeks earlier and had not been replaced yet, reportedly due to the lack of spare parts.

Typically, cracks in the concrete wall of a relatively large reservoir would occur if no construction or water joints were built into the wall, or if those joints were poorly designed and/or constructed. Without further

investigation of this case, it was not immediately clear to the team if the cracks had developed due to faulty design or construction. In either case, it was the responsibility of the implementing PVO to ensure that construction and water joints were properly designed and built into the reservoir in accordance with best engineering practices. Such an oversight would be less likely to occur if an engineering firm specialized in water infrastructure were responsible for designing the reservoir and supervising its construction.

While a US international firm may have higher relative costs for design and supervision, compared to an international NGO, the premium –or at least a fraction thereof-- should be viewed as the price that USAID has to pay to ensure quality and long-term durability of the construction works (e.g., reservoirs that do not leak after one year). See Appendix E for a comparative analysis of the costs of different water infrastructure projects implemented under different contractual mechanisms.

> Clearly, for example, it would be better for USAID to build two working water projects with a given budget rather than three projects of which one would fail.

LONG-TERM DURABILITY OF SMALL-SCALE WATER INFRASTRUCTURE

Small-scale water infrastructure typically involves basic civil works and small electro-mechanical equipment: e.g., excavating soil/rock, laying water pipelines (HDPE, iron) and fittings (Ts, elbows), installing household water meters and valves, and building small pumping stations, balancing tanks and storage reservoirs (reinforced concrete, fiberglass, etc.). Routine repair and maintenance of such infrastructure includes repairing detecting and leaking pipes, replacing meters and valves, maintaining pumps (e.g., changing oil/filters) and reservoirs, etc. Such repair and maintenance works, while very basic in nature, often require heavy equipment (e.g., backhoes to excavate and replace pipelines/fittings), specialized tools (e.g., for threading steel pipelines), spare parts (meters, valves), and skilled workers.

Most small municipalities and village councils in WBG currently do not have those capabilities and thus are not able to maintain those systems adequately and in a timely fashion. In Tarkoumiah (see Section 4.2.2), for example, the damaged/vandalized valve has not been replaced for weeks because, according to the municipality engineer, "they did not have a spare valve." It was not clear if the municipality had contacted the West Bank Water Department to inquire if they had the needed spare part. Lack of municipal funds was not cited as a reason for not addressing the problem, nor should it be since the municipality of Tarkoumiah reportedly is investing tens of thousands of dollars in upgrading its water distribution network --replacing the broken/vandalized valve would not cost more than a few hundred dollars.

The village of Markeh provides additional anecdotal evidence. There, CARE is currently building a new water connection to Mekorot that will include pipelines (3 and 4 inches in diameter), a 100 m3 balancing tank, a pumping station, and a 200 m3 storage reservoir. Water will be supplied by gravity from the reservoir to the village using the existing water distribution network. Once the project is completed, the village council will own the new water system and will be responsible for maintaining it. When asked if the Village Council had any plan on how to maintain the new system, the Head of the Village Council replied that the water project was vital for the village of Markeh and that the Village Council therefore will do whatever is needed to ensure that it will be maintained properly over time. He explained that the collection rate for water charges has dropped from over 90 percent before the latest Intifada to about 50 percent today. Clearly, the Village Council of Markeh does not have the capabilities required to maintain the new water system built with

USAID funding and the water project does not envision doing anything to develop those capabilities within the Village Council of Markeh.

OPTIONS TO MAINTAIN WATER SYSTEMS OF SMALL MUNICIPALITIES AND VILLAGES

In fact, it would not be cost-effective to develop such O&M capabilities in each small municipality or village council. Instead, such O&M capabilities are best developed at a regional level. Participants in the mid-course workshop held in Ar-Ram support the above finding. During the brainstorming session on "the most pressing needs in the water and sanitation sector in Palestine today" mentioned in Section 4.1.1, several participants identified the following *needs* pertaining to the O&M of water systems of small municipalities and villages:

- Reinforce capacity of O&M for small villages
- Review/investigate why small systems are losing money
- Building capacities of JSCs until the regional utilities are created
- Supporting formation of [future] four utilities
- Focus on local communities to sustain their water facilities

As in any brainstorming session, some of the ideas expressed are not mutually consistent.[1] For example, reinforcing the capacity of O&M for small villages may be counter to supporting the formation of four utilities. To improve the efficiency of repair and maintenance of small water infrastructure in the West Bank (and perhaps to a lesser extent in the Gaza Strip), three institutional options are possible a priori: i.e., building the capacity of:

1. A large municipality to provide O&M support to small municipalities and village councils in the region;
2. A leading Joint Services Council to provide O&M support to small municipalities and village councils in the region; *or*
3. The WBWD to provide decentralized O&M support to small municipalities and village councils in the region through a Regional Maintenance Facility.

Either of the first two options would offer the advantage of building on existing O&M capacity in a municipality or JSC, respectively. But these two options may not be feasible politically or under the prevailing closure restrictions. In the North of the West Bank, for example, the Municipality of Nablus would be the natural candidate under Option 1 as it is the largest and most centrally-located city for the northern region. However, access to and from Nablus has been extremely difficult since the Intifada, which would cripple its ability to provide regional O&M support services to small municipalities and village councils in the North. In the South, many small municipalities and villages may not accept the idea of depending on the Municipality of

[1] The goal of a brainstorming session is to collect a variety of ideas, not to reach consensus, on how to address a given question

Hebron, by far the largest and most powerful, to provide O&M support services for their water systems. In the North, the Executive Manager of the Jenin Joint Services Council, Mr. Mounir Jaradat, has offered that the JSC would be prepared to serve as a regional service center for small municipalities and village councils, either on a contract basis or subject to them joining the JSC. Of course, such a role would need to be approved by the Board of Directors of the JSC and might require amending its by-laws subject to the approval of the Ministry of Local Government. Such an amendment may not be politically feasible at this point, as the large municipalities of Jenin and Nablus likely would object to expanding the role of the Jenin JSC to providing O&M services to small municipalities and villages throughout the northern region.

In contrast, Option 3 ("Building the capacity of WBWD to provide decentralized O&M support") would offer many appealing advantages, including the following:

- Building on the successes and lessons-learned of previous procurement activities under EWOC, where commodities worth about two million dollars –water and sewage pipes/fittings, electro-mechanical equipment– were procured to WBWD and (large) municipalities. Decentralizing this procurement activity, such as through the establishment of regional maintenance centers, would enable more timely and effective response to the O&M of water infrastructure needs of small municipalities and villages; and
- Consistency with national and regional institutional development efforts, in particular near-term plans to establish a National Water Utility (bulk water supply and force main transmission) and longer-term plans to establish four regional water utilities (water distribution). In particular, the regional O&M support facilities (e.g., regional maintenance centers, O&M support procedures) that would need to be developed under Option 3 could become the building blocks of the future regional utilities.

USAID's future small-scale water infrastructure program must incorporate built-in requirements to ensure the long-term durability not only of the new water infrastructure to be built under the future program, but also of existing infrastructure previously built with funding from USAID and eventually others sources. Such requirements would need to include the provision of spare parts (pipes, fittings, valves, meters, etc.) and the gradual development of O&M support procedures (staffing versus outsourcing, receiving requests for support and responding to them, billing for the service provided, etc.).

> Linking the development of regional O&M support capabilities to actual water infrastructure projects (existing and new) minimizes risks and offers an opportunity for "learning by doing," as a prelude to the eventual formation of the future regional utilities.

DISSEMINATING THE KNOWLEDGE AND SKILLS OF LOCAL PALESTINIAN UTILITIES

Local Palestinian utilities such as WBWD, the Jerusalem Water Undertaking (JWU), the Jenin Joint Services Council, and municipalities have learned a lot about water supply and distribution from providing such services in the past. Clearly some cross learning is already taking place, as illustrated by the extensive training that the JSC staff received at the hands of the JWU in the technical, management, and administration aspects of water supply and distribution. At the same, based on the team's visits and meetings, it appears that more could be done to institutionalize this exchange of lessons learned so that Palestinian water supply and

distribution engineers and practitioners can have ready access to best engineering and management practices in this field as applied in Palestine. Organizing lessons-learned workshops and documenting best practices could help disseminate those skills and knowledge and make sure that future water projects are able to replicate the successes of previous projects and avoid or minimize the difficulties encountered.

OVERVIEW OF POSSIBLE CONTRACTUAL MECHANISMS

USAID/WBG has implemented most small-scale water infrastructure under a single contract or cooperative agreement between USAID and a contractor or international NGO/PVO, respectively (integrated package). In a few instances, USAID/WBG has implemented small-scale water infrastructure by splitting the project into two packages, one for construction supervision (with design) and one for construction, and entering into a direct contract or cooperative agreement with a firm or PVO for each package. As illustrated in Figures 1 and 2, the following mechanisms have been used (or are possible) to implement small-scale water infrastructure in WBG:

Figure 1. "Integrated Package" Contractual Mechanisms to Implement Infrastructure Projects

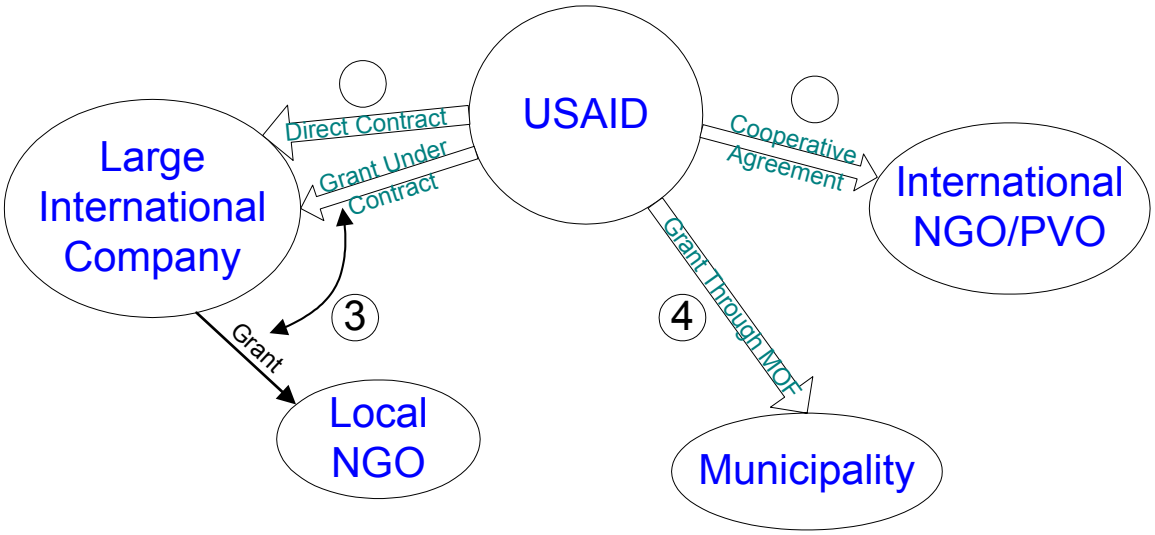
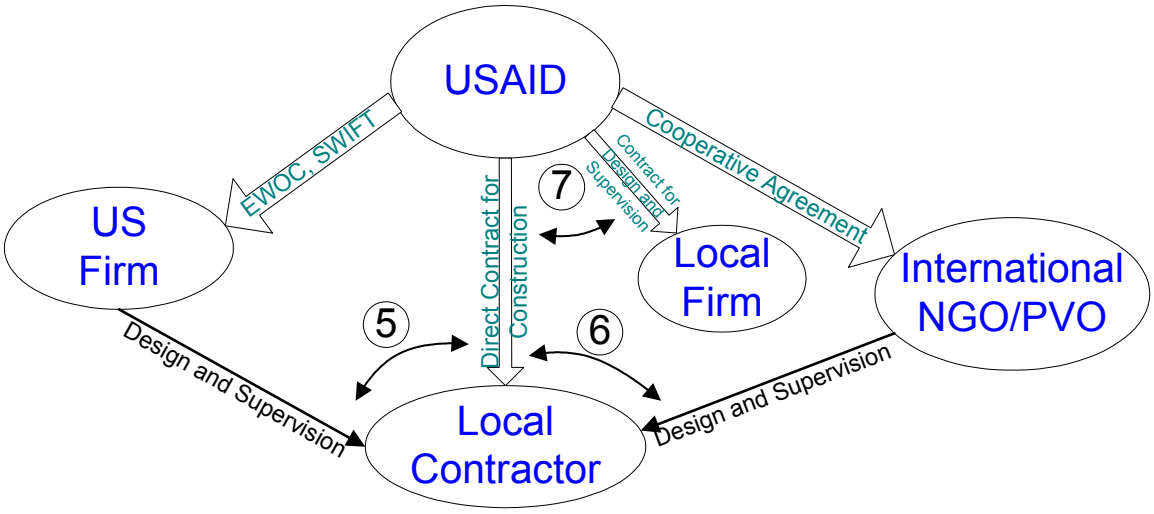


Figure 2. "Split Package" Contractual Mechanisms to Implement Infrastructure Projects



INTEGRATED PACKAGE

1. Direct contracts with large international companies, such as EWOC under CDM's EHP contract and SWIFT under CDM's Engineering IQC;
2. Cooperative agreements with international NGOs, such as ANERA, CHF, Save the Children, CARE, CHF, and UNDP, either from the Water Resources Office (WRO) or the Community Services Program (CSP);
3. Direct contracts with large international companies using the "Grants Under Contract" (GUC) mechanism to provide grants to local NGOs, such as the Rafeed Program implemented by ARD and the Tamkeen program implemented by ARD;
4. Grants to municipalities through the Ministry of Finance under the "cash transfer" program;

SPLIT PACKAGES (DESIGN/SUPERVISION PACKAGE VS. CONSTRUCTION PACKAGE, BOTH CONTRACTED BY USAID)

5. Direct contracts with local companies for construction, with (design and) supervision through an American engineering firm (e.g., under EWOC or SWIFT);
6. Direct contracts with local companies for construction, with (design and) supervision through an international NGO (e.g., under existing or separate cooperative agreements); and
7. Direct local contracting for construction and separate local contracting for design and construction management (mechanism not used to date).

PROS AND CONS OF INTEGRATED PACKAGE

VERSUS SPLIT PACKAGES

Entering into a direct contract or cooperative agreement with an international firm or PVO, respectively, to implement all aspects of a small-scale water infrastructure program would provide USAID with several key advantages as follows:

POTENTIAL PROS OF INTEGRATED PACKAGE

- One party is responsible for the project vis-à-vis USAID: In contrast, when USAID signs a contract for design/supervision and another contract for construction of a given project, responsibility for project implementation is not so clearly defined as it may not be clear-cut if responsibility for defects or malfunctions, if any, rests with one party or the other;

- Better results through integrated implementation: giving overall responsibility for project implementation to one party offers better guarantees for success thanks to better integration and coordination of efforts;

- Opportunity to provide technical assistance in support of the small-scale water infrastructure projects as part of the integrated package: Such technical assistance could include liaison with the PWA/WBWD to ensure compliance with existing strategies, plans and standards, review and approval of engineering designs, quality control of construction, and development of regional O&M capabilities to ensure the long-term sustainability of the small-scale water infrastructure built (previously or under the new program). Providing such technical assistance under one or several split packages would not be optimal, in particular because building O&M capabilities is best achieved as an integral part of implementing a project (e.g., "learning by doing"). This finding is consistent with the recommendation (see Section 3.3, Recommendations for Future Projects) to incorporate O&M concerns upfront into the project planning and design phases;

- No upper limit on the size of an integrated package contract or Cooperative Agreement with an international firm and PVO, respectively: In contrast, if the small-scale water infrastructure project/program were split into two packages that were awarded to local companies/contractors, then the contract for design/construction supervision (professional services) could not exceed $250,000 in value while the contract for construction (construction services), including construction materials required under construction, could not exceed $5,000,000 (CFR228.40, "Local Procurement"); and

- Reduced management burden on USAID as the Contractor or PVO would be responsible for managing and implementing the key aspects of the small-scale water infrastructure program under the direction and supervision of the CTO and FSNs throughout the WBG.

CON OF USING AN INTEGRATED PACKAGE: REALITY OR FALLACY?

Some construction professionals may argue that one organization should not be given responsibility for all aspects of infrastructure projects, from planning and design to construction and supervision (e.g., limited incentive to control costs under a Cost-plus-Fee basis). The merits of this viewpoint are debatable as there is ample evidence of successful projects in WBG completed under one contract, on time and within budget (e.g., WRP3, EWOC). In any case, using an integrated package need not be not synonymous with letting the prime firm or PVO conduct all aspects of each individual project under the program –planning, design, construction and supervision. In fact, under the ideal contractual mechanism (see Section 4.8), the prime contractor would be responsible for design review, quality control and overall construction supervision of all water projects, while other firms or NGOs would do the design and construction of individual projects through a grant or subcontract, respectively.

USAID has made judicious use of split packages to implement specific small water infrastructure projects with remarkable success. The Duyuk Springs and Jalameh filling point projects provide two cases in point. In both cases, USAID contracted directly with AFAQ, a local contractor, to build the project under the oversight of an international PVO: ANERA in the case of the Duyuk springs and CRS in the case of the Jalameh filling point. Both projects are working fine, providing much needed drinking water to unserved villages (Jalameh) and the Ain-Sultan refugee camp (Duyuk springs). However, the need to use such mechanisms to implement individual small-scale water infrastructure projects would be significantly reduced in the future if USAID had an integrated program dedicated to developing small-scale water infrastructure in WBG (whether through a contract, a Cooperative Agreement, or a GUC mechanism). In other words, USAID had to use these ad-hoc but ingenuous mechanisms to respond to pressing needs (but not emergency needs) to supply water when either (1) there was no umbrella mechanism that the Mission could use readily or (2) the Mission determined that the course of action chosen offered the best value the fastest way. If an when such an umbrella mechanism were put in place to implement small water infrastructure in the future, the need for these ad-hoc approaches would be significantly diminished.

PROS AND CONS OF DIRECT CONTRACT WITH LARGE INTERNATIONAL COMPANIES

POTENTIAL PROS

- Suitable for providing technical assistance
- Unique qualifications to implement specialized or large, complex projects
- Guarantee of quality assurance/quality control in accordance with "international standards"

- Less affected by local pressures: typically a US firm has no long-term presence in WBG and is less inclined to "bow" to local political pressures than US PVOs, which are typically based in country and must nurture their local image

POTENTIAL CONS

- May need more time to understand local situation (if no recent experience in WBG)
- Disruption of operations in case of evacuation
- May pose higher management burden on USAID

PROS AND CONS OF COOPERATIVE AGREEMENTS WITH INTERNATIONAL NGOS

POTENTIAL PROS

- Don't have to mobilize (existing PVOs)
- Have capable long-term local staff (existing PVOs)
- Have proven relationships with local people/ institutions
- Can continue to function in a security evacuation
- Have proven ability to:
  - Involve local community in decision-making process
  - Build local ownership and capabilities
  - Set up cost-sharing and co-financing mechanisms
- Continuing to build local PVO capability
- Less management burden on USAID

POTENTIAL CONS

- Rationale for PVO lead in an integrated package for small-scale water infrastructure in WBG is diminished as PVOs typically excel in multi-sectoral development work (as opposed to one sector such as water) in well-defined geographic areas (as opposed to anywhere "in country")
- No direct control over how funds are spent
- PVOs do not always coordinate with national agencies and master plans
- Project package may be beyond PVO mission
- PVOs cannot manage specialized or large projects

- May not take full advantage of the capabilities of local firms, or help build their capacity

PROS AND CONS OF DIRECT CONTRACT WITH INTERNATIONAL FIRM USING GUC MECHANISM

POTENTIAL PROS

- Quick response capability through network of local NGOs: Some NGOs have years of experience in certain local communities, know their needs, and have already prepared plans and draft designs for basic water projects; such NGOs would be able to "hit the ground running" to implement specific projects (under the supervision and QA/QC of an international firm). Moreover, providing grants to local NGOs under a GUC may be quicker than subcontracting to a local firm under a standard direct contract.
- Flexibility because it has no sectoral or geographic limitation: This advantage must be viewed in light of previous Cooperative Agreements under the Community Services Program whereby the Scope of Work defined clearly the target sectors (e.g., education infrastructure, water and sanitation) and PVO grantees focused on specific geographic areas

POTENTIAL CONS

- Assumes/requires NGO readiness and willingness to sign the Anti-Terrorism Certification, which has not been the case in many instances
- Burden of vetting beneficiaries receiving over $1,000 of direct assistance (the ceiling was $100 previously)
- Potential con specific to Rafeed: Grantees are not allowed to subcontract part of an activity as Rafeed is required to make all procurements of greater than $5,000 on behalf of the grantees. This creates situations where subcontracts are within an overall grant activity –including overall budget– but Rafeed directly issues and manages those subcontracts in coordination with the grantee. In those cases, the NGO grantee can continue to control overall programmatic and financial aspects of the activity, but Rafeed retains financial responsibility for subcontract components of the activity implemented by the NGO
- Con specific to Rafeed: Cannot issue grants or financial assistance directly to international NGOs, municipalities or villages councils as Rafeed's contractual mandate is to work through NGOs

PROS AND CONS OF GRANTS TO MUNICIPALITIES UNDER "CASH TRANSFER" PROGRAM

POTENTIAL PROS

- Enable local governments to:
  - Design and implement priority projects

  - Face difficult financial situations
  - Respond to emergencies
- Lowest management burden on USAID

POTENTIAL CONS

- No control whatsoever on how funds are spent
- Only largest municipalities and JSCs can deliver
- No control over quality of finished products
- No control of the timing of delivery as it has proven slow

CHARACTERISTICS OF IDEAL CONTRACTUAL MECHANISM

In light of the comparison of pros and cons of different contractual mechanisms (Section 4.3 to 4.7), and the discussion of lessons-learned (Section 4.1), the ideal contractual mechanism to implement a small-scale water infrastructure program in the West Bank & Gaza over the next few years would be for an integrated package that would allow the implementing organization to:

- Draw on the comparative skills offered by international and local firms and NGOs
- Respond to emergencies should they continue to arise
- Offer technical assistance to ensure the long-term sustainability of *small-scale water infrastructure* (e.g., built-in requirements for O&M, building blocks for future regional utilities)

Technical assistance requirements under such small-scale water infrastructure package would need to include the following:

- Provide overall coordination of the small-scale water infrastructure program
- Liaise with PWA/WBWD to ensure consistency with national plans, strategies and standards
- Manage the implementation of small-scale water infrastructure projects under the program. *For example,* work with PWA & USAID to:
  - Select priority projects
  - Prepare RFPs or RFAs and solicit bids (to ensure cost-competitiveness)
  - Evaluate proposals/applications and select winning bids
  - Award projects to PVOs, local firms or local NGOs through grants, Purchase Orders, or subcontracts
- Review engineering designs, especially for large or complex water projects (e.g., wells, force mains), for quality assurance/quality control, and provide overall supervision of construction works
- Assist PA/WBWD to:

- Set up two regional warehouses (spare parts, small equipment and repair tools), one in the North and one in the South, to provide quick-response capability for repair and maintenance of small water infrastructure in each region. These regional warehouses could become over time the nucleus of the future Regional Maintenance Centers
- Provide O&M support to small municipalities, village councils and Joint (water) Services Councils, tapping the hardware resources of the regional warehouses
- Develop O&M support procedures for small-scale water infrastructure at the regional level

SUMMARY AND CONCLUSIONS

The evaluation team spent three weeks in the West Bank meeting with all concerned stakeholders (USAID staff, US contractors and PVOs, PWA and WBWD directors and staff, local beneficiaries of water projects), visiting select water project sites throughout the West Bank, and organizing a mid-course workshop with all concerned stakeholders and a round table on O&M with PWA/WBWD staff. At the end of the mission, the evaluation team presented its draft final findings in a debriefing to USAID/WBG staff. Drawing on all those meetings and sites visits and after reviewing basic documentation, including data on project implementation costs, the team has provided answers to the two basic questions raised by USAID pertaining to:

1. The potential of different strategies and mechanisms for developing O&M capacities in different entities in the Palestinian water sector, and
2. The pros and cons of different contractual mechanisms for developing small-scale water infrastructure in WBG.

The evaluation team has recommended how USAID can best support the management, maintenance, and expansion of basic water services, both large and small.

CAPACITY BUILDING FOR O&M

Recent and ongoing capacity building efforts by USAID and other donors have put in place the major building blocks for sustainable operation and maintenance of the large water infrastructure in the West Bank, and also have highlighted some remaining gaps and limitations in basic O&M capabilities, as summarized by the following mix of strengths and weaknesses:

- A PWA/WBWD that is in a transition phase, with:
  - No current O&M responsibility for water supply wells under control of Mekorot, the Israeli water company, but which eventually would/could come under Palestinian control and O&M responsibility in the final status negotiations
  - Gradually increasing O&M responsibility for nine new public water supply wells and associated bulk water supply and transmission facilities that were built with USAID (and other donor) support and are gradually being be turned over to PWA/WBWD
- Complementary efforts of other donors, ranging from:
  - Developing the capabilities of PWA as a regulatory body, including setting tariffs (Dutch-Norwegian technical assistance)
  - Helping the WBWD transition into the National Water Utility, with a focus on improving its capabilities to manage the bulk water supply system and reduce Unaccounted for Water: e.g., detect and repair leaks,

repair bulk water meters, prepare study and TOR for a SCADA, develop Computerized Maintenance Management System (French technical assistance)

  - But none focusing on developing technical capabilities to operate and maintain the bulk water supply infrastructure built with USAID support

- A reasonably motivated O&M field team that has a set of core qualifications, acquired through hands-on and formal training and twinning with international experts, but that:
  - Lacks qualified leadership and management oversight
  - Must continue to improve its skills and know-how for basic O&M and small repairs
  - Needs to have well-defined roles and responsibilities within PWA/WBWD
- A highly performing and cost-effective well service rig and an efficient service rig team with a qualified team leader with years of relevant experience gained working in the Gulf
- A reasonably well-equipped Maintenance Facility in Ramallah, but for which:
  - Short-, mid- and long-term goals have yet to be defined (e.g., in-house diagnostics and repairs versus outsourcing)
  - Technician capabilities need to be honed through targeted training & routine practice
  - Supplemental equipment and spare parts may be needed to support its objectives
  - Linkages with the field O&M capabilities and roles must be developed
- General neglect of the O&M needs and requirements of water infrastructure owned and operated by small municipalities and villages councils, characterized by:
  - Ad-hoc and sub-standard support from WBWD due to unclear mandate, difficulties of access to different regions, lack of standardization of equipment
  - Lack of O&M response capabilities at the regional level (spare parts, repair equipment, certified technicians, O&M notification and response procedures for timely support)

Therefore, building on the lessons-learned from the capacity building efforts to date, and taking stock of the current strengths and weaknesses summarized above, the evaluation team has recommended the following measures to continue to build O&M capacity:

1. Finalize bulk water pump station construction issues to enable receipt of works by PWA/WBWD;
2. Hire an experienced, senior pump station O&M specialist to oversee the operations and maintenance of the bulk water system;
3. Conduct teambuilding and develop organizational capabilities for O&M;

4. Develop and implement an O&M plan that provides for transitioning from outsourcing of repairs to doing some repairs in-house and includes "training for results" and targeted procurement of equipment and spare parts;
5. Separate O&M of the well stations from O&M of the bulk water transmission system;
6. Address travel and access difficulties, including with regard to O&M of the Jenin 2 well;
7. Weigh carefully the implications of implementing a SCADA system;
8. Build on the Computerized Maintenance Management System to be developed under the French technical assistance program
9. Provide basic repair and maintenance equipment; and
10. Develop capabilities to estimate and monitor the short- and long-term yields of the new deep wells (and other wells, as appropriate) under anticipated operating scenarios.

TEAM'S RECOMMENDATIONS FOR FUTURE WATER PROJECTS

1. Require the review of preliminary design alternatives by relevant parties and outside experts, including Value Engineering
2. Use equipment manufacturers whose representatives can and will come as necessary to WBG
3. Keep projects as simple as possible (i.e., use appropriate technologies for WBG)
4. Conduct periodic lessons-learned workshops to share experiences and skills

DEVELOPING SMALL-SCALE WATER INFRASTRUCTURE

The evaluation team visited a selection of small-scale water infrastructure projects in the West Bank and met with the beneficiaries, implementing partners (PVOs and contractors) and operators (village councils or joint service councils) of those projects. Based on those visits and meetings, as well as the brainstorming sessions and discussions held at the mid-course workshop in Ar-Ram (May 27, 2004) and the WBWD roundtable in Ramallah (May 29, 2004), the evaluation team observed the following:

1. The need and demand for small-scale water infrastructure projects in WBG is likely to continue in the foreseeable future, even assuming an end to violence and closures;
2. In some instances, water construction projects implemented under Cooperative Agreements using local NGOs and contractors have not met basic construction quality standards (e.g., leaking water reservoirs);
3. Most small-scale water infrastructure projects are implemented without paying much attention to the basic requirements for ensuring the long-term durability of the infrastructure;
4. It may not make economic sense to build the individual capabilities of small municipalities and villages to undertake basic O&M of basic water infrastructure, such as repairing water pipelines and replacing water valves, let alone slightly more complicated equipment such as small booster pumps; and

5. More needs to be done to disseminate and build upon the skills and knowledge of local Palestinian "utilities," such as the Jerusalem Water Undertaking and the Jenin Joint Services Council, in order to incorporate the lessons learned from the Palestinian experience into the planning, design, implementation and O&M of future small-scale water projects.

6. USAID/WBG has implemented most small-scale water infrastructure under a single contract or cooperative agreement between USAID and a contractor or international NGO/PVO, respectively (integrated package). In a few instances, USAID/WBG has implemented small-scale water infrastructure by splitting the project into two packages, one for construction supervision (with design) and one for construction, and entering into a direct contract or cooperative agreement with a firm or PVO for each package.

Advantages of integrated package approach. Entering into a direct contract or cooperative agreement with an international firm or PVO, respectively, to implement all aspects of a small-scale water infrastructure program would provide USAID with several key advantages as follows:

- One party is responsible for the program vis-à-vis USAID;
- Better program results through integrated implementation;
- Opportunity to provide technical assistance in support of individual small-scale water infrastructure projects as part of the integrated package: i.e., liaison with PWA/WBWD and consistency with national plans, review and approval of engineering designs, quality control of construction, and gradual development of regional O&M capabilities;
- No upper limit on the size of an integrated package contract or Cooperative Agreement with an international firm or PVO; and
- Reduced management burden on USAID as the Contractor or PVO would be responsible for managing and implementing the key aspects of the small-scale water infrastructure program under the direction and supervision of the CTO and FSNs throughout the WBG.

At the same time, the integrated package approach should allow USAID the flexibility to build on and take advantage of the respective skills and experiences of US and local firms and PVOs/NGOs to plan, design and implement small-scale water infrastructure projects and to provide institutional development and public awareness support to such projects.

Characteristics of ideal contractual mechanism. In light of the comparative pros and cons of different contractual mechanisms (Section 4.3 to 4.7), the ideal contractual mechanism to implement a small-scale water infrastructure program in the West Bank & Gaza over the next few years would be for an integrated package that would allow the implementing organization to:

- Draw on the comparative skills offered by international and local firms and NGOs
- Respond to emergencies should they continue to arise

- Offer technical assistance to ensure the long-term sustainability of *small-scale water infrastructure* (e.g., built-in requirements for O&M, building blocks for future regional utilities)

Technical assistance requirements under such small-scale water infrastructure package would need to include the following:

- Provide overall coordination of the small-scale water infrastructure program
- Liaise with PWA/WBWD to ensure consistency with national plans, strategies and standards
- Manage the implementation of small-scale water infrastructure projects under the program. *For example,* work with PWA & USAID to:
  - Select priority projects
  - Prepare RFPs or RFAs and solicit bids (to ensure cost-competitiveness)
  - Evaluate proposals/applications and select winning bids
  - Award projects to PVOs, local firms or local NGOs through grants, Purchase Orders, or subcontracts
- Review engineering designs, especially for large or complex water projects (e.g., wells, force mains), for quality assurance/quality control, and provide overall supervision of construction works
- Assist PA/WBWD to:
  - Set up two regional warehouses (spare parts, small equipment and repair tools), one in the North and one in the South, to provide quick-response capability for repair and maintenance of small water infrastructure in each region. These regional warehouses could become over time the nucleus of the future Regional Maintenance Centers
  - Provide O&M support to small municipalities, village councils and Joint (water) Services Councils, tapping the hardware resources of the regional warehouses
  - Develop O&M support procedures for small-scale water infrastructure at the regional level

GUC-PLUS CONTRACTUAL MECHANISM TO IMPLEMENT SMALL-SCALE WATER INFRASTRUCTURE PROGRAM

If feasible, a direct contract with an international firm under a GUC mechanism, or equivalent, to provide grants (Fixed Obligation Grants or simple grants), purchase orders, and/or subcontracts to international PVOs, local NGOs, local engineering firms, and local contractors to build or rehabilitate small-scale water infrastructure in the West Bank & Gaza. Such a *GUC-plus* contractual mechanism would provide the flexibility needed for USAID to implement a wide range of water projects under a range of field conditions. It would have most of the pros of the three possible integrated package options (direct contract, Cooperative Agreement, and GUC) while at the same time minimizing the cons. Such a mechanism, if feasible, would offer the characteristics described in Section 4.8. In particular, it would ensure long-term sustainability by:

- Building O&M requirements into all projects, from design to implementation and beyond
- Building the capacity of PWA/WBWD to provide decentralized support to small municipalities and village councils
- Paving the way for one or more future Regional Utilities through the gradual establishment and operation of Regional Maintenance Centers, beginning with the establishment of regional warehouses under the program

Appendices

APPENDIX A

SCOPE OF WORK

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A.1 PURPOSE

The purpose of the Task Order is to evaluate the results of USAID's water and sanitation programs in the West Bank and Gaza in two sectors: institutional development and small-scale water infrastructure. The results are to guide the Mission in new programs.

A.2 BACKGROUND

Water resources development has been the largest program for the USAID Mission to the West Bank and Gaza since 1997. Most of the funds have gone to large infrastructure projects that serve tens- or hundreds of thousands of people, such as the Bethlehem-Hebron transmission and storage system, and the Jenin Villages program. However, significant ancillary programs of institutional development and capacity building have also been a fixture of USAID's water portfolio, and many local infrastructure projects, generally costing less than one million dollars each, have been implemented within the water program.

CAPACITY BUILDING FOR OPERATIONS AND MAINTENANCE

In Water Resources Program-Phases 1 and 2 (WRP-1, WRP-2) in the West Bank, and the Coastal Aquifer Management Project (CAMP) in Gaza, USAID's activities in capacity building focused on simple operations and maintenance of the new infrastructure in the Bethlehem-Hebron area, and development of a Joint Services Council (JSCs) for cooperative utility management in the Jenin Villages and the development of modeling and aquifer monitoring expertise and performance of routine O&M in Gaza. Work under the Water Resources Program-Phase 3 (WRP-3), now being completed, has also assisted the Palestinian Water Authority (PWA) and West Bank Water Department (WBWD) in technical operations and maintenance, financial and logistical management, strategic planning, and other institutional programs.

USAID implemented numerous institutional, and technical capacity-building programs in Gaza through the Coastal Aquifer Management Program (CAMP), especially for PWA and Gaza municipality. A new Coastal Utility is to be established under World Bank auspices, but there is currently no institution comparable to WBWD. Instead, almost all water infrastructure is owned and managed by the municipalities.

Just as the USAID and the international community (especially the Dutch and Norwegian programs) were looking to develop strong and autonomous water management institutions, the resources of PWA and municipal utility managers were exhausted by the economic crisis, limited mobility, and damages from military incursions. Notes from recent discussions with the PWA, WBWD and other donors are attached. There is a broad consensus that fundamental changes are needed in the PWA, but that they are unlikely to get the necessary political and financial support in the current atmosphere of crisis. Most fundamentally, a reliable revenue stream for O&M will probably not recover while the current instability goes on. Nonetheless, the

PWA maintains a vision of separating operational and management functions, and establishing regional water utilities. There are still opportunities to improve certain skills, and an increasing need to support routine O&M.

SMALL INFRASTRUCTURE PROJECTS

The violence and closures of the past three years have delayed the development of large water infrastructure, while forcing new attention to the repair, construction, and maintenance of local infrastructure. USAID has implemented small water infrastructure projects in the West Bank through different mechanisms. Though individually fairly modest, in the range of $50,000 to $1,000,000, the cumulative investment is approximately $20,000,000. The underlying programs were variously created for water resources development, emergency response, community development, or NGO development. The projects therefore range from the ad hoc to strategically planned elements of long-term programs. These programs also vary in technical complexity.

Various implementation mechanisms have been used:

- Direct contracts with large international companies, which should give the greatest level of technical expertise, and require the least input from USAID. We believe that this method is efficient, expensive, and vulnerable to abuse in the design phase. Responsiveness to meet political or humanitarian needs is very good. Examples include:
  - Beit Dajan and Dier Ghassoun well development (CDM-EWOC)
  - Small Water Infrastructure-Fast Track activities (CDM)
  - Various facilities built in support of WRP-3 (CH2MHill)
- Direct contracts with local companies, with supervision through an American engineering firm. This model offers the international technical quality of the turn-key contractor, along with the greater control and greater demands imposed by holding the construction contracts. Examples include:
  - Emergency Roads program (CH2MHill oversight)
  - Gaza agricultural wells (M&E oversight)
  - Gaza "demonstration projects" (M&E oversight)
  - Direct contracts with local companies, with supervision through cooperative agreements with international NGOs. This model offers the great flexibility of NGOs with a reasonable level of international oversight, but the contractual relationships can be complex, and it is not clear that this is an appropriate use of assistance agreements. Examples include:
  - Duyuk Springs (ANERA oversight)
  - Jalameh filling point (CRS oversight)
- Cooperative agreements to international NGOs, either from the Water Resources Office (WRO) or the Community Services Program (CSP). This model requires the least USAID management, but technical

capacities are lower, and assistance agreements may not be appropriate to respond to very specific requests. Other objectives, such as job-creation, may be met. Examples are:

  - Ein Sultan water supply (ANERA)
  - West Hebron reservoirs and sewers (Save the Children)
  - Nablus and Gaza water network repair and expansion (CHF)
  - Various UNDP projects

- Grants have been let to local NGOs through prime contractors under the Rafeed and Tamkeen Programs. However, implementers have sought alternative mechanisms because of difficulties stemming from "terrorism certification" requirements that are well beyond the scope of this evaluation.
- Direct local contracting for construction and separate local contracting for design and construction management. This mechanism has not been used, but may be highly flexible, inexpensive, management-intensive, and technically risky.
- Grants through the Ministry of Finance to municipalities were provided under the "cash transfer" program. USAID involvement is limited to project approval and review of completed works. In addition, EWOC has provided approximately two million dollars worth of commodities to WBWD and municipalities, mostly water and sewage pipes, but including electrical and mechanical equipment that was purchased to meet engineered specifications.

This diversity of options and activities is confusing for USAID, and for the beneficiaries, who have sometimes promoted identical or closely related activities to different USAID programs. It is unclear what situations demand international expertise for design, construction management, or project oversight. The normal trade-offs between faster, better, and cheaper are accentuated by security restrictions on USAID travel to project sites. Both Gaza and West Bank activities are of interest.

A.3 Statement of Work

This evaluation is to assess the potential of different strategies and mechanisms:

- for developing O&M capacities in different entities in the Palestinian water sector, and
- for developing small-scale infrastructure.

These are relatively distinct issues connected at the institutional level, through the Palestinian organizations that are responsible for both. This evaluation is to bring the two sets of issues together, to recommend how USAID can best support the management, maintenance, and expansion of basic water services.

The evaluation is to be based on:

- reviews of financial reports and project documents provided by USAID, contractors, and grantees;
- interviews with implementers, beneficiaries (PWA, WBWD, municipalities, village councils), and other donors;
- site visits to completed and active infrastructure projects; and
- other relevant sources of information.

Capacity Building For Operations And Maintenance

The evaluators are to consider the following issues for the West Bank and Gaza:

a. Identify which of USAID's capacity-building efforts for O&M have been most successful and can be most readily replicated or continued under present conditions. This review should specifically consider the capacity to manage facilities built under WRP-1.

b. Identify shared characteristics of successful programs in the West Bank (including those of other donors) in terms of approach, methods, partners, timing, and other important factors within the control of project planners.

c. Review the potential for capacity-building efforts in collaboration with other USAID programs, *e.g.*, governance and community services.

d. Compare the need and opportunity for institutional development and capacity-building at the "national," municipal, and village levels. Assess the feasibility of integrating O&M and other services as a preliminary step toward regional utilities.

e. Assess the need for institutional reform in PWA and WBWD, and assess the feasibility of implementing such reform during the current instability.

Small Infrastructure Projects

The evaluators are to consider the approaches used for small-scale infrastructure projects in the West Bank and Gaza (both) in terms of the following factors:

- Cost-effectiveness (implementers and USAID will provide the evaluators with summary financial information, e.g., total cost to USAID, construction and procurement, design and construction management);
- Speed of response to USAID and beneficiaries, and speed of project completion;
- Quality and appropriateness of designs;
- Quality of construction work, including adequacy and appropriateness of construction management;
- Management burden on USAID technical and contracting staff;
- Long-term benefits and sustainability;
- Support of other USAID objectives such as humanitarian assistance, job creation, and political visibility.

A.4 Schedule of Deliverables

The evaluators are expected to:

- Review background prior to arrival in-country
- On arrival, to meet first with USAID staff to collect information and agree on an overall approach
- Submit a work-plan and report outline for USAID approval within two days of arrival
- Provide USAID with weekly progress reports
- Formally present, orally, draft findings to USAID (observations, conclusions, and recommendations), along with a draft-final report
- Submit an approved final report, as follows:
  - an executive summary
  - a compact and readable report,
  - appendices as needed;
  - list of contacts; and
  - 10 copies plus electronic version.

APPENDIX B

LIST OF MEETINGS AND SITE VISITS

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Sunday, May 16

3:00 pm *Arrive* at Tel Aviv Ben Gurion Airport

Monday, May 17 (USAID/WBG, Tel Aviv)

9:15 am *Meet* with Tom Rhodes, CTO
11:00 am *Meet* with Al Newman (& Tom R.)
11:30 am *Meet* with Bob Hanchett (& Tom R.)
12:00 pm *Meet* with Bassam Refai (& Tom R.)
1:00 pm *Meet* with WR SO Team (Tom R., Al N., Bob H., Karen, Bassam R., Tony Rantissi)

PM *Prepare* meeting notes for internal reference

Tuesday May 18 (USAID/WBG, Tel Aviv)

9:15 am *Meet* with Tom Rhodes
9:45 am *Meet* with Tayseer Edeas, GIS Specialist
3:00 pm *Meet* with Ron Breen, Senior Contracts Specialist
4:00 pm *Meet* with Adel Yamak, Senior Contracts Specialist

PM *Prepare* first draft of work plan
Prepare meeting notes for internal reference

Wednesday May 19

AM Quick follow-up with Tom R., Al N., Adel Y., Hourig Khoury (Contracts office)
Begin to make appointments and firm up work plan

PM *Travel* to Jerusalem
Email draft work plan to CTO

Thursday, May 20 (Ar-Ram)

8:00 am *Meet* with Ihab Barghouti, PWA
10:00 am *Meet* with CH2MHill staff on capacity building for O&M:
- Tom Mailhot
- Hanna Nazzal
- Larry Belkin

2:00 pm *Meet* with CDM staff on small infrastructure:
- Lou O'Brien
- Bruce Soule
- L. Fernando Requena
- Mark Peters
- John Crippen

Begin to invite key potential participants to workshop orally and finalize date of workshop

Friday, May 21

AM *Visit* two WRP-1 wells in the Bethlehem area with CH2 staff and meet operators

3:00 pm *Meet* with ANERA staff:

- Thomas Neu, Middle East Representative
- Jamal El-Aref, Deputy Middle East Representative
- Jubran Said, Projects Manager

Rest (for some on the team)

Saturday, May 22

8:00 am *Visit* Beit Dajan water project (with CDM)
Attempt to enter Nablus to visit CHF water network project (turned back by IDF)

Rest *(for others on the team)*

Sunday, May 23

9:00 am *Meet* with WBWD staff:

- Mohammad Jaas, Head of WBWD
- Ibrahim Ayesh, Director of O&M Department
- Thabet Hmayel, Director of Maintenance Facility

12:00 pm *Meet* with (in addition to above):

- Albert Achten, Seureca, Resident Project Manager (French TA)
- Iyad Rammal, PMU Project Manager (French TA)

1:30 pm *Meet* with PWA staff:

- Fadl Kawash, Head of PWA in the West Bank
- Ihab Barghouti, PWA

Monday, May 24

9:00 am *Meet* with CHF staff:

- Lana Abou-Hijleh, CHF Country Director
- Henry Disselkoen, Program Director, Community Services Program
- Mohammad Said Al-Hmaidi, CHF Management Consultant
- Stephanie Hansal, CHF Program Coordinator

1:30 pm *Meet* with SCF staff:

- Mr. Jonathan Hodgdon, Field Office Director
- Ms. Amelia Peltz, Documentation and Information Officer
- Engineer Othman H.N. Abu-Hijleh, Project Manager

4:00 pm *Meet* with Claridge Hotel management staff to make arrangement to host the workshop

Tuesday, May 24

9:00 am *Meet* with:

- Eng. Raed Atrash, SCF Halhoul Office, Hebron

- Eng. Muhammad Qabaja, Tarqumia Municipality
- Eng. Imad Al Zeir, Head of Water Department, Hebron Municipality

Visit project sites in the South with Qassem Awad, USAID FSN:
- Water reservoir (built) in Tarqumia, West Hebron (Save the Children)
- Water reservoir (under construction) in Hebron (CDM)

1:00 pm *Meet* with Dr. Zeidoun Abdel-Nabi (O&M field team leader) at well station PW-11

3:00 pm *Meet* briefly with members of the field O&M Team (in addition to Dr. Zeidoun)

Wednesday, May 26

All day *Prepare* for workshop (presentation materials, logistics, etc.)

Thursday, May 27

All day *Organize and facilitate* mid-course workshop at the Claridge Hotel in Ar-ram

Friday, May 28

Rest

Saturday, May 29

9:00 am *Meet and brainstorm* with O&M and management staff in a round table at WBWD:
- Eng. Mohammad Jaas, Head of WBWD
- Eng. Ibrahim Ayesh, Director of O&M Department
- Eng. Thabet Hmayel, Director of Maintenance Facility
- Eng. Zeidoun Abdel-Nabi, Head of Field O&M Team
- Eng. Khairy Masoud, WBWD
- Eng. Issa Kheir, WBWD
- Eng. Fadi Musa Abdel-Ghani, Field O&M Team
- Eng. Said Nasser Eddin, Field O&M Team
- Eng. Mohammad Abed El A'al, Field O&M Team
- Eng. Issam Mohammad Ammar, Field O&M Team

Sunday, May 30

Work on report and debriefing

Monday, May 31 (field trip in the North of the West Bank)

8:30 am *Leave* Jerusalem

10:30 am *Visit* Jalameh Filling Point and Village Council and *meet* with:
- Mr. Amer Abu Farha – Village Council Accountant
- Mr. Musleh Shaaban, Al Jalameh Water Filling Station Operator

1:00 pm *Visit* Jenin Joint Services Council and *meet* with:
- Mr. Ayman Mousa – JSC Accountant
- Mr. Sufian Zyoud – Water Networks Technician
- Mr. Mazen Mer'i – Water Networks Technician

- Mr. Ayman Sbeihat – Water Networks Technician

2:00 pm *Visit* Rommaneh reservoir and pumping station

4:00 pm *Visit* Markeh village and water reservoir project and *meet* with:
- Eng. Nedal Mousa, Care site engineer
- Eng. Imad Abu Al Rub, Village Council representative
- Eng. Hazem Hanin, PHG
- Mr. Husam Obeid, Contractor
- Head of Village Council

Tuesday, June 1

9:00 am *Meet* with USAID staff in charge of the Community Services Program:
- Thomas Dailey, Office Director, General Development Office
- Gaby Abboud, Development Assistance Specialist, GDO

Work on debriefing and draft report

Wednesday, June 2

9:00 am *Meet* with RAFEED staff (ARD) in Ramallah:
- Jan Auman, Chief of Party
- Kirsty Wright, Deputy COP
- Eng. Raed Halaseh, Engineering and Environmental Manager
- Youil Anastas, Engineer

11:00 am *Meet* with Eng. Mounir Jaradat, Executive Manager of the Jenin JSC, in Ramallah

Work on debriefing and draft report

5:00 pm *Meet* with Lou O'Brien, EWOC Chief of Party (CDM)

Thursday, June 3

7:45 am *Meet* with Ihab Barghouti, PWA

Work on debriefing and draft report

Friday, June 4

9:00 am: *Debriefing* at Mission

2:30 pm *Leave* WBG (Joseph K.)

Saturday, June 5

5:00 am *Leave* WBG (Barnes B.)

APPENDIX C

MID-COURSE WORKSHOP REPORT

APPENDIX C:
MID-COURSE WORKSHOP REPORT

Workshop On Approaches for O&M and Small-Scale Water Infrastructure
Thursday, May 27, 2004
8:30 am to 2:00 pm
Jerusalem Claridge Hotel (Ar-Ram)

C.1 PURPOSES

The purposes of the workshop were to ground-truth and discuss the preliminary evaluation of the following:

- Possible approaches to developing O&M capacities to ensure the sustainability of water sector investments in the West Bank and Gaza, and
- Pros and cons of different contractual mechanisms to develop small-scale water infrastructure.

In addition, workshop participants were to"

- Identify gaps and opportunities for additional investigations to refine the evaluation, and
- Exchange ideas and lessons-learned.

C.2 AGENDA

Workshop Agenda (As Executed)

8:30 am *Registration*

9:00 am **S.1 Introductions:**

- Purpose of evaluation mission and workshop
- Introduction of participants
- Workshop guidelines
- Brainstorming exercise on:
  "What are the most pressing (near-term) needs of the water/sanitation sector in Palestine?"

10:00 am *Short break*

10:20 am **S.2 Approaches to Develop O&M Capacities in WBG:**

- Recent and planned capacity building efforts (presentation)
- Brainstorming exercise on:
  "What are the most pressing needs to build O&M capacity in the water sector in WBG?
- Presentation and discussion of preliminary team observations and findings

12:00 pm *Coffee break*

12:30 pm **S.3 Mechanisms for Developing Small-Scale Water Infrastructure:**

- Recent and ongoing approaches to develop small-scale water infrastructure (presentation)
- Pros and cons of using different contractual mechanisms (facilitated group discussion):
  -- Integrated package vs. split packages (one for design & CM and one for construction)
  -- If integrated package, cooperative agreement (w/ PVOs) vs. contract (with US/local firm)
  -- Cash transfer to municipalities, village councils, or Joint Service Councils

2:20 pm **S.4 Evaluation and Wrap-up:**

- Group evaluation of the workshop (successes and difficulties)
- Next steps

3:00 pm *Lunch and Adjourn*

C.3 WORKSHOP PARTICIPANTS

No.	Name	Organization	Telephone	Fax	Email
1	Dr. Ihab Barghouthi	PWA	02-2409022	02-2409341	pwaiib@palnet.com
2	Mr. Muhammad Jaas	WBWD	02-2958747 02-2408660	02-2958748 02-2408747	
3	Mr. Issa Khair	WBWD	02-2958747 02-2408660	02-2958748 02-2408747	
4	Mr. Ibrahim Ayesh	WBWD	02-2958747 02-2408660	02-2958748 02-2408747	
5	Mr. Thabet Hmayel	WBWD	02-2958747 02-2408660	02-2958748 02-2408747	
6	Dr. Zeydoun Abed Al Nabi	WBWD	02-2958747 02-2408660	02-2958748 02-2408747	
7	Mr. Tom Mailhot	CH2MHILL	02-2344611-9	02-2344620	tmailhot@meg.palnet.com
8	Mr. Hanna Nazzal	CH2MHILL	02-2344611-9	02-2344620	
9	Ibrahim Abu Siag	Contract Int.	02-5401637		
10	Mr. Lou O'Brien	CDM	02-2342068	02-2342066	
11	Mr. Bruce Soule	CDM	02-2342068	02-2342066	
12	Mr. Taher Nasser Eddin	CDM	02-2342068	02-2342066	
13	Mrs. Lana Abu Hijleh	CHF	02-2345671	02-2345674	labuhijleh@chf-pal.org
14	Mr. Muhammad Hmaidi	CHF	02-2345671	02-2345674	hmaidi@palnet.com
15	Mr. Jubran Sa'id	ANERA	02-6277076	02-6264351	jubran@anerB-jwg.org
16	Mr. Othman Abu Hijleh	SCF	02-5833683	02-5835771	oabuhijleh@scuspalestine.org
17	Mr. Wa'el Al Zaghal	AFAQ	02-2981090	02-2960542	
18	Mr. Imad Al Sha'ar	CEP	02-2955655	02-2955654	emad@cep-palestine.com
19	Dr. Hafez Shahin	UG	09-2383281-2	09-2383280	shaheen@eug-maalem.com
20	Mr. Alvin Newman	USAID	03-5114825	03-5114888	
21	Mr. Tom Rhodes	USAID	03-5114825	03-5114888	
22	Mr. Gaby Abboud	USAID	03-5114825	03-5114888	
23	Mr. Tom Daily	USAID	03-5114825	03-5114888	
24	Mr. Tony Rantisi	USAID	03-5114825	03-5114888	
25	Mr. Bassam Refa'i	USAID	03-5114825	03-5114888	
26	Naser M. Abu Halaweh	JWU	02-2969191		Naser@JWU.org
27	Mr. Pascal Jansen	ICRC	02-5828441	02-5811375	assist.jer@icrc.org
28	Leo Pizarro	USAID	03-5114825	03-5114888	
29	Naim El Mani	PWA	02-2766101	02-2766106	Naim_elmani@yahoo.com
30	Stephanie Hansal	CHF	02-2345671	02-2345674	shansal@chf-gazB.org
31	Khaled Ghazal	V.M.S	02-2963516		Khaled.ghazal@vision-con.com
32	Barnes Bierck	ECODIT	+1 919-401-0591		sludge1@minsdpring.com
33	Nader Al-Khateeb	ECODIT	02-2747948	02-2745968	wedo@p-ol.com
34	Joseph Karam	ECODIT	+1 703-841-1883	+1 703-841-1885	ecodit@aol.com

C.4 SESSION 1: INTRODUCTIONS

C.4.1 PURPOSE

Session 1 began with an overview of the workshop. Participants introduced themselves to the group, and the facilitator provided an overview of the program beginning with the purpose of the workshop. Goals and techniques of brainstorming were also reviewed, in a lead-up to the first brainstorming exercise.

C.4.2 BRAINSTORMING EXERCISE

The brainstorming exercise asked the question, " What are the most pressing needs in the water and sanitation sector in Palestine?" Results from the exercise are shown in Table C-1.

Table C-1
Results of brainstorming exercise on
"What are the most pressing needs in the water and sanitation sector in Palestine?"

• Improve water quality in rural areas • Prepare and implement O&M program for the entire water sector • Construct WWTP in Gaza (for reuse), & North WB • Upgrade existing agricultural wells to support drinking water • Manage and coordinate existing know-how to maximize output (e.g., Data Bank for Water) to improve water and sanitation • Improve water networks in Palestine • How to get more water to satisfy future needs • Develop small WWT Systems for reuse in irrigation • Generate revenue streams to insure sustainability • Increase water supply sources in Palestine • Reinforce capacity of O&M for small villages • Management plan for water to mesh with existing sources (Develop aquifer management) • Take stock of recent efforts in single locations	• Review/investigate why small systems are losing money • Develop new or alternative water sources for unserved 200 villages in WB • Plan where we are, where we want to be & how to achieve it • Develop telemetering & controls – link to repair • Information system awareness for small rural 11 communities on wastewater treatment and reuse • Standardize equipment procedures for O&M in WBG • Focus on local communities to sustain their water facilities • Building capacities of JSC until the regional utilities are created • Set criteria & guidelines for priorities • Define roles & responsibilities between PWA, WBWD & municipalities • Supporting formation to utilities (4)

C.4.3 HIGHLIGHTS OF SESSION 1

Introductions held during Session 1 revealed the diversity of attendees, which included representatives from virtually the entire spectrum of stakeholders relevant to the evaluation project. The brainstorming exercise went very well, helping build an atmosphere of geniality and openness, helping set the tone for the workshop. Many of the ideas presented were further elicited as the workshop proceeded.

A number of themes were revealed during the brainstorming exercise on the most pressing needs in the water and sanitation sector in Palestine. These themes included examining ways to increase and improve the management of available water supplies, and addressing water (and sanitation) needs of smaller communities. It was clear that many workshop participants recognize the value of water reclamation and reuse in helping save valuable fresh water supplies for potable purposes. Organizational issues were also noted, including planning for the future, improving use of existing facilities (through O&M capacity-building) and know-how, and clarifying roles and responsibilities for the various agencies involved (PWA, WBWD, municipalities, Joint Village Councils, etc.).

C.5 SESSION 2: APPROACHES TO DEVELOP O&M CAPACITIES IN WBG

C.5.1 PURPOSE

The purpose of Session 2 was to examine O&M capacity building efforts and needs in the West Bank and Gaza. The session included a review of previous, ongoing and planned O&M capacity building, a brainstorming exercise on pressing O&M needs, and an interactive presentation and discussion of preliminary observations.

C.5.2 REVIEW OF PREVIOUS, ONGOING AND PLANNED O&M CAPACITY BUILDING EFFORTS

This review covered both hard (equipment) and soft O&M capacity building to date. The review proceeded by noting major equipment items, along with training courses and workshops held to train both operations and maintenance staff, as well as staff performing aquifer modeling. O&M components of the French (through Seureca) project involving development of a National Water Utility, infrastructure review, computerized management systems, and a SCADA (supervisory control and data acquisition) study were also reviewed.

C.5.2 BRAINSTORMING EXERCISE ON O&M NEEDS

The brainstorming exercise on O&M capacity asked the question, "What are the most pressing needs to build O&M capacity in the West Bank and Gaza?"

Results of the brainstorming exercise are shown in Table C-2.

Table C-2
Results of brainstorming exercise on
"What are the most pressing needs to build O&M capacity in the West Bank and Gaza?"

• Procedure to procure spare parts and to contract outside services & develop/secure funding • Develop performance indicators for system operations • Test bench for submersible pumps to diagnose problems • Establish more workshops, in S, in N, for maintenance • Develop, encourage, & finance local subcontractors for maintenance & operations support • Integrate O&M in education system (long term plan) vocational centers & university • Find local solutions to local problems like subcontractors • Monitor and evaluate system before reacting • Use Management Information Systems in O&M • Need foreign experts to work more closely with local engineers especially at well sites • Develop procedures to replace old engines of private wells especially in the north	• Weave O&M needs into project planning (at start/conceptual stage) • Develop criteria to evaluate performance of maintenance team • Practice, practice, practice using existing facilities 1. Have regular programs for practice 2. Train identified people 3. Identify needs for spare parts & tools • Add/mobilize resources to O&M sector (W&S of Hebron, Jenin, Northern) material, etc. • Working with local municipal groups not serviced by WBWD • Emphasize O&M support needs for small communities

C.5.3 PRELIMINARY OBSERVATIONS ON O&M CAPACITIES AND NEEDS IN WBG

A spirited discussion of preliminary observations to date followed the brainstorming session. This workshop component elicited a number of comments on specific O&M difficulties that need addressing.

C.5.4 HIGHLIGHTS OF SESSION 2

Needs for equipment and training were major items noted during the session on O&M capacity needs. Equipment needs mentioned include various instruments for testing well station components, a second well

service rig, a test bench for testing pumps, other equipment for the maintenance center at Ramallah, spare parts, tools, a well equipped maintenance truck, and a crane (or truck-mounted lifting winch). Training suggestions include long term integration of O&M training in the vocational schools and at colleges and universities; use of foreign experts in "hands-on" mode; and practicing basic procedures. Training (such as that held in Jordan) on equipment that is not on-hand in WB/G was mentioned as being a training (and equipment) issue, because training on equipment that one does not have is futile, unless there are clear plans for obtaining that equipment.

Organizational issues were noted, including needs for setting criteria and guidelines for prioritizing O&M needs, defining roles and responsibilities among O&M staff, utilization of local subcontractors for certain repairs (and other private sector roles), and use of management information system approaches for O&M. Other suggestions included standardizing equipment procedures for O&M, distinguishing between short- and long-term O&M needs, incorporating O&M needs from project conception, development of criteria for performance evaluation of the O&M team, and the need for using a spare parts inventory system (which may have been done already). It was also noted that it will be helpful to define and allocate roles and responsibilities between the PWA, WBWD, and municipalities. In addition, the current inactivity of the Joint Water Committee was noted as being problematic.

Means for addressing transportation difficulties were suggested. These approaches include establishing regional equipment and maintenance facilities in the north and south. Another transportation difficulty is high expense of vehicle rental as opposed to purchase (which was proscribed by import restrictions the last time purchasing was attempted). It was suggested that vehicle purchases be tried again.

O&M needs of small utilities were noted. Large utilities (such as Hebron City) can, for the most part, fend for themselves, while small utilities often must rely on the WBWD or outsource repairs. In this regard, the difference between JSCs and Tech Centers should be appreciated. Large municipalities should be encouraged in some way(s) to aid smaller neighbors with resource constraints. Until regional utilities are created, it will be helpful to continue community approaches, including building the O&M capacities of JSCs, and creating new JSCs where possible.

Larger issues attached to water supplies were also noted. There are real concerns over sustainable yields, and integration of water supply approaches with the Israelis. Financial constraints on O&M is another important consideration, and it was noted that the Palestinian Authority should make specific budget allocations for O&M of water and sanitation facilities. Vandalism is a problem in part attributable to access controls.

C.6 SESSION 3: MECHANISMS FOR DEVELOPING SMALL-SCALE WATER INFRASTRUCTURE

C.6.1 PURPOSE

The purpose of Session 3 was to review the pos and cons of different contractural mechanisms used by USAID o develop small-scale infrastructure in WBG.

C.6.2 HIGHLIGHTS OF SESSION 3

The different USAID contracting mechanisms were discussed. These mechanisms include integrated packages for all services through a contract with a US/international firm, or a cooperative agreement with a US/international NGO/PVO. Split packages are another overall approach, these consisting of construction via a direct contract with a local contractor, with supervision through a contract with a US/international engineering firm or via a cooperative agreement with a US/international NGO/PVO.

Various pros and cons of the different contracting mechanisms were discussed. It was noted that integrated packages can be faster than the other approaches, and that increasing the number of small packages reduces risk. The CSP program director, Mr. Tom Dailey noted that the type of mechanism chosen depends on the particular project. In the case of NGOs/PVOs, these organizations can generally better mobilize the local community and use local know-how.

Other approaches to implementing small scale infrastructure projects were examined. These mechanisms include cash transfers to local governments and use of two contracts with local firms: one for construction, and another for supervision.

The session concluded with a request that the various implementers of small-scale infrastructure projects supply cost data for representative projects.

C.7 SESSION 4: WORKSHOP EVALUATION AND WRAP-UP

C.7.1 PURPOSE

The purpose of this final workshop session was to examine

- Successes of the workshop, and how to replicate or build on these successes in the future, and
- The difficulties of the workshop, and what should be done to avoid or minimize them in the future.

C.7.2 WORKSHOP SUCCESSES AND DIFFICULTIES

Flipcharts from the session are presented in Tables C-3 and C-4.

Table C-3
Workshop Successes

- Diversity of participants from different backgrounds
- Exchange of information
- Workshop well organized
- Getting everyone's priorities and preferences stated
- Touched on many points for small groups
- - Procurement mechanisms
- Showed different approaches & opportunities for O&M by PWA & WBWD
- Hearing different points of views
- The way things were presented
- Venue enabled every body to attend
- Avoiding past mistakes
- Should lead to more discussions
- USAID shown that everybody cares

Table C-4
Workshop difficulties and how to address them

Difficulty	Suggested Approaches to Addressing Difficulty
A. Going to 3 pm until lunch	Have a lunch break
B. The choice of Thursday for the workshop	Any day except Thursday, Friday or Saturday
C. Timing	Stay on schedule; do not allow discussions to go on beyond scope
D. No Gaza information	Get that info; add/conference them in
E. Brainstorming/discussion of ideas not prioritized	Need more time for that, or different schedule

C.7.3 HIGHLIGHTS OF THE SESSION

Attendance was excellent, reflecting keen interest in the evaluation effort and its goals. Attendees included representatives of numerous NGOs/PVOs, construction contractors, large US contract engineering firms, the PWA and the West Bank Water Department. USAID representatives included individuals from three different groups: community services program, water team, and contracts.

Workshop organization was complimented, although scheduling could have been better in terms of having lunch closer to lunchtime. Having everyone's priorities and points of view stated, and touching on so many ideas, were considered major accomplishments of the workshop. The venue was considered to have been a good one, as it allowed all participants to attend under current travel restrictions. Thursday was considered not to be an optimal day for a workshop.

APPENDIX D

ROUND TABLE REPORT

APPENDIX D
ROUND TABLE REPORT

Round Table Meeting on Capacity Building for Operations and Maintenance at WBWD

Saturday, May 29, 2004

9:15 am-2:00 pm

D.1 PURPOSE OF MEETING

Our purposes from this meeting were to:

1. Bring together WBWD staff and field staff with O&M responsibilities

- Get a better understanding of WBWD's perspective on:
- The status of the current water supply infrastructure

2. Staffing and organization to operate and maintain the water system
3. Hear from the O&M field team members about their job functions
4. Brainstorm with the O&M team about:

- Successes and accomplishments in capacity building for O&M
- Difficulties and gaps and what needs to be done about them

D.2 MEETING PARTICIPANTS

In addition to the evaluation team, the following 11 staff members from the WBWD and PWA participated in this meeting:

Table D-1
Name, Organization and Position of WBWD and PWA Staff Member

Name	Organization, Position	Tel.
Eng. Muhammad Jaas	WBWD, Director	059-814080
Eng. Ibrahim Ayesh	WBWD, Head of O&M	059-814086
Eng. Thabet Hamayel	WBWD, Head of Ramallah Maintenance Center	059-840038
Eng. Issa Khair	WBWD, Mechanical Engineer	059-814073
Eng. Khairy Masoud	WBWD, Mechanical Engineer	052-694727
Dr. Zeidoun Abed Al Nabi	PWA/WBWD, Head of O&M Field Team	059-814079
Eng. Fadi Musa Abdel-Ghani	PWA/WBWD, O&M Field Team	0593358910
Eng. Saed Nasser Eddin	WBWD, O&M Field Team	054-264302
Eng. Mohammad Abed El A'al	WBWD, O&M Field Team	052-654707
Eng. Issam Mohammad Ammar	WBWD, O&M Field Team	059-679375
Dr. Barnes Bierck	ECODIT	+1 703 841-1883
Eng. Nader Al Khateeb	ECODIT	052-875022
Eng. Joseph Karam	ECODIT	+1 703 841-1883

D.3 OVERVIEW OF WATER INFRASTRUCTURE (ACCORDING TO WBWD DIRECTOR AND STAFF)

D.3.1 NEW WATER INFRASTRUCTURE

The WBWD currently owns and operates (or will operate) seven wells in the South, plus one in the Abou Diss area. In the North, the Jenin Municipality owns and operates a ninth well but the WBWD is in difficult negotiations with the Municipality to buy that well from them (no agreement on price yet).

To date, the WBWD has not received any of the seven wells in the South. Four of those wells have been operating for periods ranging from two weeks to two years as follows:

- JWC-4 well: operating for two years now, 24 hours a day (24/24);
- Izzariya-2 well: operating for one year now, 24/24;
- Izzariya-1 well: operating for seven months now, 24/24; and
- PWA-11 well: operating for two weeks now (20/24).

The other three wells are not currently operational:

- PWA-1 well: submersible pump is in but need instrumental devices;
- PWA-3 well: expect to install submersible pump by mid-June;
- Hindasa well: expect to install submersible pump by mid-June;

The Abu-Diss well station is currently working with one horizontal booster pump; the other two horizontal pumps are out for repair.

CDM is currently changing the impellers on all horizontal pumps of the WRP1 (Phase I) well stations.

In the South, several packages for well stations, booster pumps, main pipelines and tanks/reservoirs are either under construction or up for bidding, financed by USAID, AFD (French Development Agency), and the World Bank. All of those packages are to be implemented and delivered by 2006. In the North, EIB (European Investment Bank) is funding a project to drill and equip a well and build booster station, main pipelines, and reservoirs to18 communities Southeast of the Municipality Nablus.

According to Dr. Zeidoun, WBWD still has not received the four WRP2 wells because there are defects with the horizontal wells. Also, WBWD has not received the WRP1 wells because they have a problem with the impellers.

D.3.2 OLD WATER INFRASTRUCTURE

In 1982, the Government of Israel shifted responsibility for operating 13 wells in the West Bank from the WBWD to Mekorot. Many of those wells are concentrated in the South. Mekorot currently supplies drinking water to WBWD through those 13 wells and other wells in the West bank and in Israel. WBWD maintains some of the pipelines and reservoirs associated with the old water supply system but none of those 13 wells.

D.3.3 ORGANIZATIONAL CHART

Clearly the organization of the WBWD and PWA is in a transition phase. WBWD currently has 3 divisions, none of which includes officially the O&M team headed by Dr. Zeidoun. The intent is to create a South Utility for Maintenance (or something like that) to be headed by Dr. Zeidoun. The current field O&M team includes Dr. Zeidoun as Head, four engineers, and four operators in each well station. Mohammad Jaas has reiterated what he said at the Thursday workshop, that they do not have an O&M plan for the new infrastructure, considering that they have not received those works yet.

MJ explained again that nobody on the WBWD side knows exactly why those pumps kept failing and stressed the need to develop such expertise at WBWD. He acknowledged that WBWD has missed an opportunity to be more involved in the design and implementation of the well projects. He believes that WBWD "are not doing our job fully" such as by reviewing and commenting draft reports prepared by USAID's contractors. In other words, if they don't have comments on draft reports, that means they've approved them. WBWD staff are used to relying on visual observations after the project is implemented.

According to Dr. Zeidoun, the root of the problems does not lie in the choice of submersible pumps (rather than vertical line shaft pumps). He believes that submersible pumps have been used elsewhere, for example in oil fields at greater depths, and are more economical at depths of more than 500 meters. Dr. Zeidoun suggested that some problems may be due to deficiencies in the design and specifications, while others are due to improper implementation by contractors or supply of equipment that does not meet the specifications.

D.3.4 WATER CHARGES COLLECTION

Mohammad Jaas explained that collection of water charges by the WBWD has dropped from 80 percent before the Intifada to 25 percent until recently, but that collection rates have risen to about 36 percent now. The WBWD has received today (Saturday May 29) NIS5 Million from the Ministry of Local Government as payment of arrears owed by municipalities and village councils to WBWD. The MoLG normally would transfer such amounts to local governments but in this case it seems that MoLG has decided instead to transfer those funds to WBWD directly to ensure that amounts owed to it by local governments get paid actually.

D.4 WHAT THE FIELD O&M TEAM DOES (ACCORDING TO THE TEAM ITSELF)

- Supervise the lowering of the submersible pump into the well and the connection of splices
- Disassemble the motor pump system of vertical booster pumps, conduct routine maintenance on parts, and reassemble the parts after repairs have been done (outsourced). *JK: what about horizontal pumps?*
- Test instrumentation devices, such as pressure switches, flow switches and level switches, and do minor on-site fixes as needed (e.g., recalibrate)
- Verify that flow meters and data loggers are working properly, using portable flow meter and M scope, respectively
- Maintain and update GIS for WRP1 well stations (e.g., operational data, maintenance records on equipment). Different members of the field O&M team enter different data pertaining to their areas of expertise and responsibility (e.g., electrical vs. mechanical). GIS is installed on an old Pentium II desktop. GIS has not been extended to WRP2 well stations as the O&M team is still waiting for the as-built drawings
- While the team has received a short training course on MP2, they believe that MP2 is too complicated for their purposes and needs supporting programs. The team prefers using GIS
- Perform routine maintenance of generators and motors: e.g., change oil and oil filters, change water filters, greasing, test pump insulation
- Maintain and repair check valves (or no-return valves), gate valves, control valves, etc. (they rely on private workshops to do laith (spelling) work to repair or manufacture parts)
- Verify that electrical systems are working properly: e.g., disassemble contactors and clean off dust
- Help resolve administrative issues and conflicts that may arise between operators. Each engineer is responsible for the administration of two well stations, including their operators
- Ensure that valves continue to function properly (e.g., open and close routinely to avoid rust build-up)

- Train the operators and give them assignments. Have identified about a dozen capable operators who can assist as technicians in maintenance tasks (e.g., installing flow meters): six on electrical tasks and six on mechanical tasks
- Supervise maintenance works performed on the main transmission lines (from wells to reservoirs) and conduct small maintenance jobs (e.g., butterfly valves).

D.5 WHAT THE FIELD O&M TEAM DOES (ACCORDING TO THE TEAM ITSELF)

We did not tell the central O&M team to come to the meeting prepared to present their job responsibilities. Engineers Issa and Khair explained that they provide support to small municipalities and villages in planning, designing and implementing well pumps, pumping stations, booster stations, pipeline networks, etc.

D.6 SUCCESSES AND DIFFICULTIES IN CAPACITY BUILDING FOR OPERATIONS & MAINTENANCE

D.6.1 SUCCESSES AND ACCOMPLISHMENTS IN CAPACITY BUILDING FOR O&M

- Training session in Jordan on technical and management aspects of the maintenance of submersible pumps
- Short training course on the GIS and EPAnet software and application of these two software tools at work
- Seeing and learning from maintenance and repair works performed on vertical and horizontal pumps in Haifa
- Getting introduced to electrical power generators and performing routine maintenance on them
- Training session in Jordan on measurement instruments and electrical systems
- Benefiting from daily contact and work with international experts, such as Virgin Norcus, Bruce and Bill, on managing and implementing maintenance operations, documenting data, preparing plans, etc.
- Training of the WBWD Maintenance Facility staff in Jordan and Kalandia, but we're waiting for the facility to begin operations
- Operations training in Haifa and Akka regarding the WRP2 well stations
- Equipping the team with two vehicles for maintenance purposes
- Equipping the team with a service rig for submersible pumps
- Training on the use of data loggers
- Provision of electrical testing devices, such as multi-meter, clamp meter, resistance meter, temperature meter
- Training in first-aid, fire fighting, English language
- Equipment of the field O&M office (desks/chairs, shelves, etc.)
- Putting a yellow-plate car and driver at the disposal of the field O&M team
- Provision of small tools such as keys (?), drillers
- Provision of communication tools (walkie-talkie) over a one-year period
- Provision of equipment and vehicles such as excavators, cranes, and compressors

D.6.2 DIFFICULTIES IN CAPACITY BUILDING FOR O&M

Table D-2
Difficulties in Capacity Building for O&M
and Suggested Approaches for Overcoming Them

Difficulty	Suggested Approaches to Addressing Difficulty
A. Most of our O&M needs/difficulties are concentrated in the South and access/travel to the South is difficult	Create an integrated maintenance unit/facility for the South to maintain well stations, transmission lines. May require more training
B. Insufficient capabilities to maintain	Organize specialized and extended training sessions, each in his/her own speciality
C. When pumps (submersible, horizontal or vertical) stop working, we send them to Israel to maintain or repair them. Same for meters	Finish equipping and start using the Ramallah Maintenance Center to repair those pumps and meters locally
D. Inability to take full advantage of devices such as data logger, relay management unit, etc.	Provide laptops for use in data downloads, data analysis, and reporting
E. Lack of some equipment/tools (e.g., test and calibration) that are needed to maintain the well stations and were to be supplied for the Ramallah Maintenance Center	Equip a field laboratory with such equipment/tools in the South
F. We lack the skills necessary to solve water hammer and surge problems	Provide software on water hammer and surge analysis and train staff in its use and application
G. We have a problem in O&M and calibration of check valves (or no-return valves) and control equipment and modifying/adapting the hydraulic system (e.g., water hammer) under the integrated water system for WRP1 and WRP2	Need practical training in solving those issues, including developing and more training on the hydraulic model for the integrated water supply system
H. Weaknesses in the capabilities and competencies of the operators	Provide systematic training to operators and train the trainers (e.g., O&M engineers)
I. Problem of access/transportation (to site) and communication (among staff)	Need to secure a car with yellow license plate and field communication devices

After having identified the above nine difficulties and associated needs, the participants were asked to rank the nine areas of needs from one ton nine. The table below presents the individual priorities given by each participant and the average scores resulting from those individual preferences.

Table D-3
Priorities Assigned to the Nine Areas Requiring Additional O&M Capacity Building

Participant	I	H	G	F	E	D	C	B	A
Zeidoun	7	9	3	4	2	6	8	5	1
Ibrahim	7	9	6	8	4	5	1	3	2
Khairy	9	8	4	3	6	7	1	5	2
Issam	5	8	7	9	3	2	6	1	4
Mohammad	4	8	7	9	3	2	6	1	5
Saed	3	9	8	7	2	5	6	1	4
Fadi	1	5	4	9	6	8	3	2	7
Thabet	7	8	6	5	4	3	1	2	9
Issa	9	8	6	5	4	7	1	2	3
Average	5.8	8.0	5.7	6.6	3.8	5.0	3.7	2.4	4.1
Order of Priority	7	9	6	8	3	5	2	1	4

D.7 SUCCESSES AND DIFFICULTIES OF ROUND TABLE MEETING

D.7.1 SUCCESSES OF ROUND TABLE MEETING

- Through you, we convey our ideas/opinions and problems to the decision-makers and the donors
- There was consensus on ideas and consensus on the overall problem
- We were able to focus on difficulties posed and possible solutions
- Opportunity to site together and voice our ideas and opinions
- First time we meet colleagues and learn about their needs and opinions
- Getting to know the opinions of others (what the others think)

D.7.2 DIFFICULTIES OF ROUND TABLE MEETING AND WHAT TO DO ABOUT THEM

- Short time to prepare for the meeting; no advance warning. Some participants had to cancel prior appointments to attend the meeting
  - Give attendees sufficient time to prepare for such a meeting. Provide an agenda in advance to help attendees think about the issues before coming to the meeting
- There is some tension within the team
  - Need to be able to express opinions in a team spirit and without enmity

APPENDIX E

COMPARATIVE COSTS OF SMALL-SCALE WATER INFRASTRUCTURE PROJECTS

APPENDIX E
COMPARATIVE COSTS OF SMALL-SCALE WATER INFRASTRUCTURE PROJECTS

To aid in the comparison of different contractual mechanisms used by USAID/WBG, the evaluation team obtained cost information on a selection of small-scale water infrastructure projects. Other factors important for comparing contractual mechanisms include the management burden to USAID staff; support of other USAID objectives, such as humanitarian assistance and job creation; project timing (quick response); long-term benefits and sustainability; and quality and appropriateness of construction. Costs must be viewed through the lens of these other evaluation criteria when examining different projects and the underlying contractual mechanisms. Sections 4.3 through 4.7 provide a detailed analysis of the pros and cons of different contractual mechanisms in light of these different comparison factors.

The team requested cost information for 10 projects falling into one of three project types:

- Water reservoirs;
- Water distribution pipelines;
- Water filling stations; and
- Mixed water projects (combining reservoirs and pipelines).

For each project, the evaluation team requested the total cost of the project to USAID as well as the breakdown of this total cost into four cost elements: design, construction supervision, construction and management. Table E-1 summarizes the cost data obtained from one US contractor (CDM) and four international PVOs (ANERA, SCF, CHF, and CRS) for the 10 selected projects. Unfortunately, some of the cost information is incomplete (and could not be obtained or examined with more detail within the time limits of this evaluation). For example, it was not possible to obtain design cost data on the water distribution networks for the 11 villages west of Jenin --those networks were designed by CDM several years ago under WRP1 and there is no readily available information on the design costs for those networks as this design task was part of a much larger design and construction effort under WRP1.

In addition to total costs, the evaluation team obtained information on project dimensions (e.g., capacity of storage reservoirs in cubic meters, length of pipelines laid in meters) and/or the number of beneficiaries. The team then derived unit costs of eight of the 10 projects for which sufficient data were available. Those unit costs provide some insights into the comparative costs of same-type projects, but the team advises against drawing hard conclusions regarding the cost-effectiveness of these projects based on those unit costs alone because no two projects are alike. For example, two water reservoir projects may have different components such as water piping under a reservoir project but not under another. In some cases, design costs are included in the total costs of a project but not into the total costs of another project of the same "type." In other instances, project implementation has included investments in institutional development or public awareness activities, which are above and beyond the standard cost elements of design, construction, supervision, and related management. Finally, even similar projects may have different costs due to markedly different field/project conditions such as the type of soil to be excavated (e.g., soft soil vs. hard rock), delays caused by closures, damage to equipment and works caused by incursions (requiring doing the job over), or the type of materials used (e.g., fiberglass, steel or concrete reservoirs).

E.1 WATER RESERVOIRS

The Tarqumia and Hebron reservoirs were implemented using Contractual Mechanisms 2 and 1, respectively (see Figure 1). The Tarqumia project included (1) an elevated, 1000 cubic-meter reservoir providing water storage and pressure head for Tarqumia, a municipality of about 15,000 inhabitants, and (2) pipelines for routing low-pressure water from the main supply pipeline to the reservoir, and from there to the town's network. The Tarqumia reservoir project was implemented through a cooperative agreement with SCF (Save the Children), which contracted with a local NGO, the Palestinian Hydrology Group (PHG), for implementing the project (i.e., construction management and supervision). This concrete reservoir followed a PWA design.

The "Hebron reservoir," currently under construction, will serve the Habail El Riah area in the City of Hebron. The original 3,750 cubic-meter design was found to be too large to fit within the designated site. CDM reviewed the master plans for the area and found that a 2,000 cubic-meter storage reservoir would be sufficient through 2020. Accordingly, CDM redesigned this concrete reservoir for a capacity of 2,000 cubic meters and is currently managing and supervising its construction by a local contractor hired by CDM for this particular reservoir.

As shown in Table E-1, when the $50,000 contribution from the Municipality of Tarqumia is taken into account, the costs per cubic meter of reservoir capacity are comparable for the two projects ($184/m3 for Tarqumia vs. $178/$m^3$ for Hebron). If other things were equal, one would expect the unit costs ($/$m^3$) of the Hebron reservoir to be smaller than the unit costs of the Tarqumia reservoir due to economies of scale (the Hebron reservoir is double the size of the Tarqumia reservoir). In fact, considering that the Tarqumia project costs include the costs of building a pipeline from the main pipeline to the elevated reservoir, in addition to the costs of the reservoir itself, one would expect the unit costs of the Hebron project to be much smaller than the unit costs of the Tarqumia project. But other things are not equal, as explained below:

1. The Tarqumia project costs do not include any costs for the design of the reservoir, which was prepared by PWA. Assuming design costs equal to supervision costs for the Tarqumia project (i.e., $11,696), not an unusual assumption, then the total unit costs of the Tarqumia project would be $190/ m^3, or only slightly more than the unit costs of the Hebron project. No information was available on the costs of the pipeline component of the Tarqumia project;

2. The combined design and construction supervision costs for the Hebron reservoir represent 36 percent of the total costs of that reservoir, or a mark-up of 57 percent above the construction costs alone. Typically, design and construction supervision costs do not exceed 15 to 20 percent of construction costs. CDM has explained that they incurred high design costs because they had to revise the Master plan calculations to verify the storage capacity needs of the reservoir project.

> Perhaps the design of the reservoir included the engineering specifications required to ensure that cracks do not form and the reservoir does not leak (e.g., construction and water joints), in which case the construction contractor either misread those specifications, implemented them incorrectly, or omitted them altogether in the actual works. Clearly, the construction supervisor must ensure that projects are built according to the engineering design/specifications, in particular that the contractor does not cut corners to save money (as most contractors will try to do without close supervision). It is the design engineers' responsibility to ensure that the design and specifications of the concrete reservoir include the necessary safeguards to ensure that cracks do not form in the sidewalls of a reservoir.

The Tarqumia reservoir is not currently receiving water, pending the replacement/repair of a valve part and control components that were stolen from the pipeline system (see Section 4.1.2). Also, the reservoir wall has cracks from which water leaks out (leakage rate unknown). Isolated on a hilltop, the reservoir site lacks a security fence, and operations personnel inspect it infrequently. At the June 4 debriefing, some attendees noted that the Tarqumia reservoir case is unusual for a construction project implemented by an NGO; others suggested that NGOs should not be charged with construction projects of this nature.

E.2 WATER DISTRIBUTION PIPELINES

E.2.1 THE JENIN 11 VILLAGES PROJECT

CDM designed the water production and distribution system for the 11 villages west of the City of Jenin, including the Jenin 2 well, booster station, reservoirs, transmission line, and village-level distribution network (secondary lines), under WRP1. Construction of the village-level networks was not undertaken under WRP1. Instead, USAID issued a separate Request for Applications (RFA) for the construction of the village-level distribution network, institutional development of the Jenin JSC, and public awareness. Two Cooperative Agreements were awarded as a result of this RFA: one to ANERA for the construction of the distribution networks in five villages and the institutional development of the Joint Services Council for the 11 villages, the other to SCF for constructing the distribution networks in the other six villages and raising public awareness. Both PVOs contracted with the Center for Engineering Planning (CEP) for the construction supervision of the water distribution networks.

As indicated in Table E-1, the ANERA Cooperative Agreement cost $94 per meter of pipeline built in the five target villages while the SCF Cooperative Agreement cost $93 per meter of pipeline in the remaining six villages. These costs do not include the original costs incurred by CDM to design the village distribution networks; they do include the costs of institutional development activities by ANERA and public awareness activities by SCF. When the costs of these institutional development and public awareness activities are subtracted from the total costs, the cost per meter of network piping was about $88 per meter of network piping (for each PVO). The Jenin 11 Village project also includes transmission mains, storage, booster stations, and the Jenin 2 well. Thus, institutional development (and public awareness) activities represent a relatively small percentage of total project costs. The JSC's responsibilities include O&M, accounting, billing and collection, and other traditional aspects of a viable water supply network. As described in Section 2.2, the 11 Villages west of Jenin have been able to keep their systems repaired and operating, despite working under difficult security (incursions) and economic conditions (decreased collection rate), thanks to the dedication, knowledge, and skills of the JSC's personnel and the support of the public.

> The Jenin 11 Villages project illustrates another ingredient of success: leveraging international engineering expertise with local engineering know-how. The Palestinian firm CEP reviewed the engineering design, specifications and Bills of Quantities of the US firm CDM and put them in a format and language that are compatible with local construction standards and practices.

E.2.2 CHF WATER NETWORK PROJECTS

Most water network projects built by CHF are relatively small projects in urban neighborhoods, averaging $41,950 in total cost and about 4,000 meters in total pipe length (or an average cost of about $10 per meter of pipe installed). This unit cost is substantially lower than unit costs of the Jenin Villages networks. The reasons for this discrepancy were not fully investigated by the evaluation team. Installed pipe costs depend on the type of soil to be excavated, the presence of other underground utilities, the type and diameter of pipe (e.g., steel, HDPE), and the cost of labor. Many of CHF's projects were implemented with the USAID-mandated objective of creating jobs, using labor-intensive techniques. Given low labor rates (about $10 per day for unskilled labor), important cost savings may be achieved in this way (albeit at the expense of speed of implementation). Further, CHF projects had significant in-kind contributions ranging from 25 to 40 percent of total costs. Another reason why the CHF average installed pipe cost is comparatively low may be the use of small diameter pipe (in urban neighborhoods).

The cost analysis presented above points unequivocally to the importance of institution building and public participation to the long-term success of water distribution projects.

E.3 FILLING STATIONS

Table E-1 shows three filling station projects built by USAID in Jalameh, Beit Dajan, and Kufur Deek, which are all in the North West Bank. The Jalameh filling station project included a 4.2 km pipeline connection to

the main Mekorot line, four 50 cubic meter fiberglass tanks mounted on an elevated concrete platform (over two stories high), and ancillary equipment (e.g., meters, small pump, etc.). The local contractor AFAQ built this project under a lump-sum contract with USAID worth about $733,000. CRS provided construction supervision under a separate Cooperative Agreement with USAID worth about $55,000. PWA designed the Jalameh filling station; hence USAID incurred no design costs for this project. Construction and supervision costs represent 93 percent and 7 percent of total costs to USAID, respectively.

A separate cost for the 4.2 km pipeline has not been made available. However, the pipeline cost is likely to have been at least half of the total project cost. One advantage of the separate contract with USAID in this case is that the construction contractor chosen had experience working in this particular area, and was able to handle expeditiously the transportation and site access issues created by incursions and checkpoints. In addition, the lump-sum nature of the contract resulted in relatively easy contract administration, as opposed to a Bill of Quantities approach.

The Beit Dajan filling station project includes a deep well (relatively) and well pump, storage tanks, generator, and booster pumps. The Jalameh filling station is comparable to the Beit Dajan filling station in design delivery rate: 1,000 m^3/day versus 1,200 m^3/day, respectively. Unit costs of the Beit Dajan station were $941 per m^3/day compared to $788 per m^3/day for the Jalameh station. Here again, there was no information on the separate costs of the water well and well pump. Therefore comparisons are difficult to make between the two stations in terms of unit costs. It is noteworthy, however, that design, supervision and management costs represented about 33 percent of the total costs of the Beit Dajan filling station, or a mark-up of about 50 percent over construction costs alone. As in the case of the Hebron reservoir (see above), this mark-up appears to be far in excess of similar benchmarks in industrialized countries. Clearly a big portion of this difference is probably due to the unusual planning and construction work conditions in Palestine: difficulties of negotiating with the Israelis to obtain their approval of water projects, closures and incursions, all which cause significant delays, reviews of designs, and sometimes even redoing the works to repair damages caused by Israeli incursions.

Like the Jalameh filling station, the Kufr Deek filling station also ties directly to a Mekorot transmission main. Because it does not involve a long pipeline, nor a deep well and other infrastructure, the cost of the Kufr Deek filling station is much less than that of the Jalameh and Beit Dajan stations. Nevertheless, the reliability of filling stations with feed water controlled by Mekorot is not likely to be as high as the Beit Dajan station, which is an independent source (provided the well is operated and maintained properly and pumping rates stay within the sustainable yield limits).